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Combustion Control and Furnace Design

By G. W. Akerlow*

Industrial furnaces are built and operated for the production of heat necessary to carry on the processes requiring heat in the industrial plant. Heat is evolved by allowing oxygen to come in contact with a combustible, under proper conditions of temperature and draft, etc.; the burning of the fuel then is nothing more nor less than a simple chemical process. This being the case, combustion can be investigated and controlled by the application of some simple chemical principles. The function of the furnace is to develop the maximum amount of heat from a given quantity of fuel. In order to carry out this function with the highest efficiency it is necessary that the furnace operator as well as the designer of the furnace have a clear understanding of combustion and the principles upon which it depends. It is also essential that the furnace be equipped with instruments so that its performance may be controlled.

Without question, practical experience is of great value, but if practical work is not founded upon a knowledge of the theoretical considerations and facts that govern it, maximum efficiency cannot be obtained. That this is a fact has been proven both by practical experience and tests. For instance, the design of the furnace and the treatment of the fuel vary for different types and classes of fuels. As an example, a glass tank furnace designed for burning natural gas will be considerably less efficient should oil be used for heating.

The great interest shown in fuel saving during the last few years can be ascribed to fuel shortage, and its attendant high cost. This condition of high fuel costs will not be improved as time goes on but rather the contrary. It is up to the engineering profession to lead the way and show how we may best conserve our fuel resources.

THE CHEMISTRY OF COMBUSTION. The subject of combustion is not a very difficult one, the underlying principles being few and simple. In order to gain a clear and comprehensive view of this science, it would seem to be advantageous to set forth a few of the chemical laws upon which the whole structure rests.

It is possible to regard matter as infinitely divisible; according to human conception the smallest particle that can really be obtained is still capable of division into an infinite number of still smaller parts. However, even the ancients were of the opinion that there must be somewhere a limit to the divisibility, and that we must finally arrive at particles incapable of further division. This ultimate particle has been called an "atom," but atoms very seldom exist alone; they usually travel around in groups of two or more. These groups have been called "molecules," and when two or more of these elementary molecules meet under proper conditions we have a union which then is called a compound. The actual act of union is known as an "chemical reaction." The elementary molecules which will be of interest in combustion are hydrogen, oxygen, nitrogen, carbon and sulphur. In chemical nomenclature all of the elements are represented by letters or symbols made up from the first or the first two letters in the Latin name of the element. Compounds of the elements are designated by a group of these symbols with subscripts indicating the number of atoms contained in the molecule. For example, the formula H_2O for water indicates that two atoms of hydrogen and one atom of oxygen are combined to form one molecule of water. The number of molecules contained in the compound is designated by placing a numeral in front of the group symbol.

Experiments tend to show that the atoms of the different elements have different relative weights. However, the atomic weight of any one of the elements is always the same and further, the atoms of any one element are all alike. It has also been shown that the proportion, or number of atoms combining to form a compound is at all times the same. For example, carbon dioxide, CO_2, always contains one atom of carbon and two atoms of oxygen. There can be no change from this combination, and this fact that the elements always unite in certain given proportions is so well established that it has been formulated into a law known as the law of constant proportions. The chemical reactions taking place between the different elements can be expressed in the form of an equation made up of the symbols representing the various elements entering into the reactions. These equations become very significant in that they show not only how the atoms

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unite to form the compound but also the proportionate weights of the elements entering in the molecule. Table 1 gives the symbols and molecular weights of the elements and compounds generally encountered in combustion work.

TABLE 1

Element or Compound	Symbol	Atomic Weight	Molecular Weight	Chemical Reaction
Carbon	C	12	..	
Hydrogen	H_2	1	2	
Oxygen	O_2	16	32	
Sulphur	S_2	32	64	
Nitrogen	N_2	14	28	
Carbon dioxide	CO_2	..	44	$2C+2O_2=2CO_2$
Carbon monoxide	CO	..	28	$2C+O_2=2CO$
Methane	CH_4	..	16	$CH_4+2O_2=CO_2+2H_2O$
Acetylene	C_2H_2	..	26	$2C_2H_2+5O_2=4CO_2+2H_2O$
Ethylene	C_2H_4	..	28	$C_2H_4+3O_2=2CO_2+2H_2O$
Ethane	C_2H_6	..	30	$2C_2H_6+7O_2=4CO_2+6H_2O$
Sulphur dioxide	SO_2	..	64	$S+O_2=SO_2$
Sulphur trioxide	SO_3	..	80	$2S+3O_2=2SO_3$
Hydrogen sulphide	H_2S	..	34	$2H_2S+3O_2=2H_2O+2SO_2$
Water vapor	H_2O	..	18	$2H_2+O_2=2H_2O$
Air		..	29	

From the above table it will be noted that two different compounds of carbon and oxygen are possible. If sufficient amount of air (oxygen) is present and the combustible is thoroughly mixed all of the carbon present will be oxidized and all the heat due to this reaction will be developed. In most cases it happens that there may be enough and even too much air present, but the furnace is of poor design and mixing of the gases does not take place. In this event the reaction is only carried half way through and only about one-third of the heat evolved. Of course the same thing happens when the air supply is restricted or insufficient. In any case where the carbon in the fuel is not completely oxidized there will occur a waste of fuel for which there is no excuse as it is within our power to stop or prevent this waste.

Considered from the standpoint of heat production, combustion may be defined as the rapid combination of the combustible elements of the fuel with oxygen. To accomplish this it is essential that the combustible have a ready affinity for oxygen. It is very fortunate that all of the commonly used fuels contain carbon and hydrogen, which elements occur in the fuel in either the free or combined state. Both carbon and hydrogen have a great affinity for oxygen, and for this reason meet the requirements admirably.

All of the combustibles are found in nature and so also we find the supply of oxygen to support the combustion in the atmospheric air, which is a mechanical mixture of oxygen, nitrogen, carbon dioxide, water vapor, and some other inert gases. The proportions of oxygen and nitrogen can be taken as practically constant. The generally accepted values are:

Oxygen 20.91 per cent and Nitrogen 79.09 per cent by volume, and
Oxygen 23.15 per cent and Nitrogen 76.85 per cent by weight.

The percentages of carbon dioxide, water vapor and inert gases are very small and are classed with the nitrogen.

The mere fact that a combustible is brought in contact with oxygen does not of necessity mean that combustion will follow. The temperature must be high enough to ignite the combustible before the reaction between it and the oxygen can take place. As the affinity of oxygen for carbon and hydrogen increases as the temperature is elevated, the combustion once started will continue until all of combustible is consumed or the oxygen supply is exhausted. The ignition temperature of different combustible substances varies considerably. Table 2 gives some approximate figures on ignition temperatures, collected from various sources.

TABLE 2

Combustible Substance	Ignition Temp. Deg. Fahr.
Lignite dust	300
Dry peat	435
Sulphur	470
Fixed carbon—Bituminous coal	766
Fixed carbon—Coke	800
Fixed carbon—Semi-bituminous coal	870
Fixed carbon—Anthracite coal	925
Acetylene	900 to 1076
Ethane	1000
Ethylene	1022
Hydrogen	1135 to 1290
Methane	1202 to 1436
Carbon monoxide	1200 to 1210

The most interesting fact about these figures is that they are so surprisingly high for gases, considerably higher than the ignition point of coal dust.

WEIGHT AND VOLUME OF GASES. In order to be able to compute combustion data, that is, weight and volume of gases handled in the furnace, it is necessary to know something about the density and volume of gases encountered in combustion practice. Unlike solids and liquids, gases are influenced by temperature and pressure and when dealing with the volume or density of a gas the temperature and pressure must be stated. The pressure-temperature-volume relation of any gas is best expressed by the characteristic equation for a perfect gas, viz.:

$$PV=RT$$

in which P=absolute pressure in pounds per square inch.
V=volume of gas in cubic feet.
T=absolute temperature.
R=gas constant, which varies for different gases and is inversely proportional to the molecular weight of the gas and is given by the the relation 1544/mol. weight.

The absolute presure must not be confused with the gauge pressure. The ordinary pressure gauge reads the difference in pressure between the atmospheric pressure outside of the gauge tube and the applied pressure inside of gauge tube. The absolute pressure is equal to the gauge pressure plus the barometric pressure, which is approximately 14.7 at sea level.

A perfect gas contracts 1/491.6 of its volume for each degree that it is reduced in volume. Therefore if the temperature could be lowered to a point of 491.6 degrees below 32 degrees its volume would become zero. The absolute temperature then is figured from an imaginary point 492 degrees below the freezing point on the Fahrenheit scale. In other

words, to convert temperatures on the ordinary scale to the absolute scale it is necessary only to add 492 — 32 = 460 degrees to the temperatures expressed in degrees Fahrenheit.

The equation of a perfect gas shows that the volume will increase with a rise in the temperature and decrease with a rise in the pressure. With pressure unchanged, at temperature t′ the volume becomes:

$$V' = \frac{V\,(t' + 460)}{t + 460}$$

and as most of the work connected with combustion problems deals with little or no change in pressure but considerable change in temperature the above relation will be found very useful when calculating the volume of gases at high temperatures. For example, the volume of one pound of air at 32 degrees F. is 12.39 cubic feet, what will be the volume if the air is heated to 800 degrees F.? Applying the formula and substituting the values given we have:

$$V' = \frac{12.39\,(800 + 460)}{32 + 460} = 31.744 \text{ cu. ft.}$$

In table 3 is given all the data for various gases that may be found to be useful in the calculations of combustion problems. The data are given at standard conditions of atmospheric pressure and a temperature of 32 degrees F. and are recalculated from various sources.

In combustion work the analyses of gases are usually given in terms of volume, but when making calculations it is better to have the analyses given in terms of weight. To convert a volumetric analysis into one by weights the percentage by volume of each constituent gas should be multiplied by its relative density, each product being divided by the sum of the products. On the other hand to convert an analysis by weight to one in terms of volume, the percentage by weight of each constituent gas should be divided by its relative density, and each quotient so obtained be divided by the sum of the quotients. Since the molecular weights of the various gases bear the same relations to each other as the relative densities, these molecular weights may be used in transforming analyses instead of the relative densities.

TABLE 3

DENSITY, WEIGHT AND VOLUME OF GASES
at atmospheric pressure and 32 degrees Fahrenheit

Substance	Relative Density Air=1	Relative Density H=1	Weight per Cu. Ft. in Pounds	Volume per Pounds in Cu. Ft.	Value of Constant R in PV=RT
Air	1.0000	..	.08071	12.390	53.33
Oxygen	1.1053	16	.08921	11.209	48.24
Hydrogen	0.0696	1	.00562	177.936	765.8
Nitrogen	0.9673	14	.07807	12.809	55.13
Carbon monoxide	0.9672	14	.07806	12.811	55.15
Carbon dioxide	1.5291	22	.12341	8.103	34.88
Methane	0.5576	8	.04500	22.222	95.64
Acetylene	0.9200	13	.07425	13.468	59.97
Ethylene	0.9674	14	.07808	12.807	55.12
Ethane	1.0494	15	.08470	11.806	50.81
Sulphur dioxide	2.2639	32	.18272	5.473	23.56
Carbon	.....	..	145	.0068	....
Sulphur	.....	..	125	.008	....

Another method of converting volumetric analyses to analyses in terms of percentage by weight is through the use of the weights per cubic foot of the various gases constituting the gas under examination. The percentages by volume are multiplied by the weights per cubic foot, and each product is divided by the sum of the products. The method has the advantage that it gives directly the sum of the products, the weight of the gas per cubic foot.

(*To be continued*)

Glass and Electricity*

By F. A. Connor†

The art of making glass is one of the oldest in existence—for six thousand years men have lived and died in order that you might see the world through your plate glass window or find yourself reflected flawlessly in your mirror. Some one has said that the invention of glass was an accident into which a group of Phoenician merchants stumbled while cooking on the sand in the dim days of antiquity. According to history the Phoenicians beached their galleys on the coast of Palestine. When they had built their camp fires and tried to set up their cooking pots to prepare a meal they failed to find any stone in that desert country, so the pots were set up on cubes of soda from their cargo. The heat of the fires melted the soda and fluxed it with the sand and to their amazement they beheld a clear fluid forming as a result of the fluxing—glass.

Now here is where science tells us something. It says that to produce a fluxing of sand and soda a heat of 2,600 degrees F. would have been necessary and that cooking fires didn't get that hot even in hot Palestine. You say you found glass in the Temples of the Fourth Dynasty, 4,000 years B. C., eh? Where did those Egyptians get their 2,600 degrees Fahrenheit? Quite unable to answer, a deep blush of humiliation mantles the brow of history.

Getting down to more modern times it is stated that the first glass factory in the United States was built in the woods near Jamestown, Va., in 1608, and that the chief product was glass beads. Afterwards in many places bead factories sprung up proving a cheap kind of mint, as great profit was made by trading with the Indians. It is stated that one was established near Hanover Square, in New Amsterdam, to give the Dutch burghers a chance to recoup their fallen fortunes after paying twenty-four dollars for Manhattan Island.

Methods in the plate glass industry, as we know it today, have changed very little in principle since about 1690 when it was first established. Stepping into the present, this article is primarily to describe the plant of the Ameri-

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†General Electric Co., Pittsburgh, Pa.

can Plate Glass Company at James City, Pennsylvania.†

This is a very modern plate glass factory and every mechanical requirement in this complete industry is met by electric motors ranging in size from one to four hundred horsepower in approximately 135 units. Ninety-seven per cent of the 10,652 horsepower connected load is developed by General Electric motors. All of the A. C. motors are 550

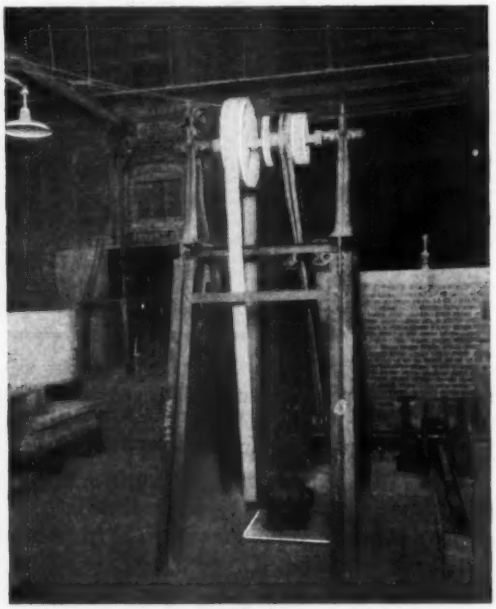

FIG. 1.

volt, 3 phase, 60 cycles, except those in the pump house, which is some distance away, which are 2,200 volt, 3 phase. The D. C. motors are 125 volts.

Plate glass is made from a mixture consisting of pure silica sand, soda ash, limestone, salt cake, with small quantities of arsenic and charcoal, a proportion of cullet or scrap glass being remelted with the batch. The mixture is placed in clay pots and melted in gas-fired furnaces. The modern gas-fired furnace will usually accommodate twenty pots, and eight such furnaces are in use at this plant.

In making glass the mixture is first dumped into batch wagons, which haul it to filling machines which are placed near the furnaces. The filling machine is in the form of a bin, which moves along on wheels and is propelled by a small motor. In front of each furnace an operator opens a gate in the filling machine, which allows some of the mixture to fall into a ladle and this, in turn, manually enters through the furnace door and delivers its charge to the clay pots. The pots in the furnace are already heated to approximately 2,000 deg. F., and after the mixture has melted down they are refilled several times in order to make up for shrinkage in the batch. The pots, with the mixture, are then subjected to a temperature of approximately 2,600 deg. for from 14 to 15 hours, during which the melting and fusing process goes on. Just before the pots are ready to be taken out the temperature is reduced to approximately 2,000 deg. F. At this temperature the batch is suitable for casting. All temperatures are regulated by recording pyrometers. When ready for casting, the pot is removed from the furnace by special tongs carried on an overhead traveling crane and delivered to the teeming crane, which grasps it in its jaws, where it is held tight by a hand-operated screw-down.

Considerable care is required for the making of the clay pots, and as there is no machine that will mold them successfully it is necessary that this be done by hand. Clay is the only practical material for the making of the pots, which must stand a temperature of approximately 2,700 deg. F. Up to a few years ago the only practical way of making a velvet-smooth surface free of air pockets was by tramping with bare human feet. In these modern times a pug-mill driven by an electric motor does this work. Twelve to sixteen weeks are required for molding and drying the pots, and after all of this tedious work the pots are good for not more than 20 trips into the melting furnace. Each pot is 43 in. in diameter by 31 in. deep and holds 1,800 pounds of glass. The pots are slowly dried and then preheated in a furnace kiln and pushed through this kiln by means of the motor-operated mechanism shown in Fig. 1.

The filled pot after being taken from the furnace and

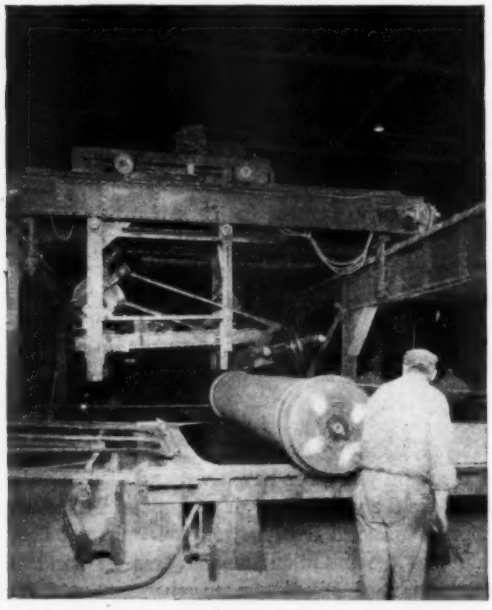

FIG. 2

while still in the clutches of the teeming crane has the bottom cleaned by letting it rest slightly on revolving steel brushes which knock off all loose pieces, and the sides are also thoroughly blown off to remove any foreign matter which might fall on the casting table.

After the molten glass has been skimmed by means of copper tools which are worked around the top in order to remove any impurities, the pot, still in the jaws of the teeming crane, is taken to the opposite side of the 13 ft. 6 in. x 22 ft. flat surface steel casting table, the top of which has already been covered with a very thin layer of fine sand to prevent sticking and chilling of the glass, and the contents poured or "teemed" in front of a huge knurled cast iron

†The writer wishes to acknowledge the courtesy and assistance extended him in obtaining photographs and information by the American Plate Glass Company.

roller, the teeming crane being given a quick direct forward movement and the contents poured along in front of the roller. The roller, which is 26 in. in diameter by 15 ft. long and weighs approximately 13 tons, is then started in motion, being pulled by a chain connected to a motor. Crane type D. C. motors are used on the special four-motor teeming crane.

A good view of the teeming crane, the casting table and a

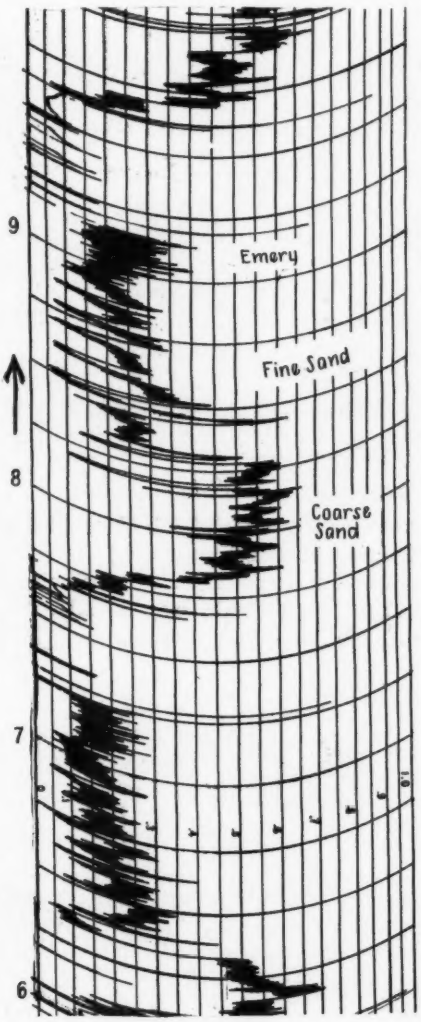

FIG. 3

portion of the molten plate glass while the roller is being passed over it can be seen in Fig. 2. The roller at the end of its travel mounts on wedges placed on either side, which raise it slightly above the glass, permitting the plate of glass to pass under it. After the glass has cooled for a few seconds it is pushed from the table into the first annealing oven. The pushers or stowing tools operate in regular successive movements and push the plate of glass, after certain intervals of time, into five separate ovens, which have a graded downward temperature, the first being 1,200 deg. F. From the fifth oven the glass is pushed onto conveying rods and into a 300 ft. lehr, and still through gradually reducing temperatures moves along the lehr until it comes out at the other end, three and one-half hours afterwards, annealed and cooled to approximately 190 deg. F. While the glass is in the lehr it is carried along on lehr rods in steps of approximately 15 ft., the operation being by semi-automatic motor control. The interior of the lehr is lighted by arc lamps. When the glass leaves the lehr it is trimmed and examined in order that pieces having serious defects such as "stones" may not be put through the expensive process of grinding and polishing. By means of specially designed cranes the glass is then taken to the rough storage racks until ready for grinding.

The annealing lehr and also several of the special appliances for handling the glass were designed by J. W. Cruikshank, plate glass engineer, of Pittsburgh.

The plate is laid on the grinding tables in glass stucco, a mixture of gypsum and lime, which is quick drying. This

FIG. 4.

composition holds the glass on the table, but in order to further avoid accident due to centrifugal force wooden pegs are also placed around the outer edges of the plates to prevent slippage.

Over each circular cast steel grinding table, which is 28 ft. 6 in. in diameter and weighs approximately 45 tons, two grinding runners or discs, one of large diameter weighing 8 tons, and one of smaller diameter weighing 5 tons, are lowered on the plate glass. The under-surface of these runners are covered with brick-like blocks of cast iron, each block weighing approximately 13 pounds when new. The two runners revolve in the same direction as the table and varying grades of sand and water are then placed upon the glass.

These runners receive their motion entirely from the friction produced between them and the plate glass and are not revolved by any external source of power. Due to the roughness of the glass at the beginning of the grinding process the table revolves at about 15 R.P.M., and after this period of

approximately five minutes it is increased to the full speed of 26 R.P.M.

The grinding process is finished by means of different grades of emery placed upon the plate glass. This emery is ground and pulverized in a ball mill which is operated by a 40 HP. motor. The huge grinding tables are each driven by a 300 HP. slip ring induction motor, running at 514 R.P.M. synchronous speed. A typical load curve on

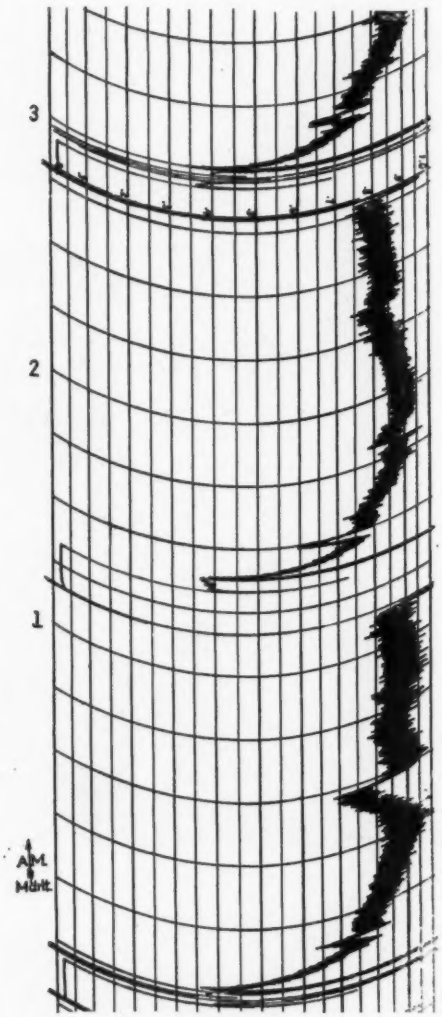

FIG. 5

one of these grinder motors is shown in Fig. 3, the full scale being 400 KW.

Approximately one hour is required for grinding each side of the glass. After the plate has been ground to a perfect plane on one side, while still remaining on the same table it is taken to the middle yard, where the plaster joints between the plates are raked out, any broken plates removed, unbroken plates substituted, new plaster run in between all the joints, and the plate and the table are then taken to one of the polishing machines. Each polishing machine is equipped with four runners, and attached to each runner are a number of circular blocks approximately 18 in. in diameter, and to the under side of each a felt pad is attached. These felt blocks bear against the surface of the glass. Red rouge or roasted sulphate of iron held in suspension by water is then applied for polishing. The polishing tables revolve at approximately 22 R.P.M.

After an hour and twenty minutes of this and a repetition of the whole process for the opposite side of the plate, all that man has been able to learn in sixty centuries about making perfect plate glass has been done.

Each polishing table is driven by a 400 HP. slip ring in-

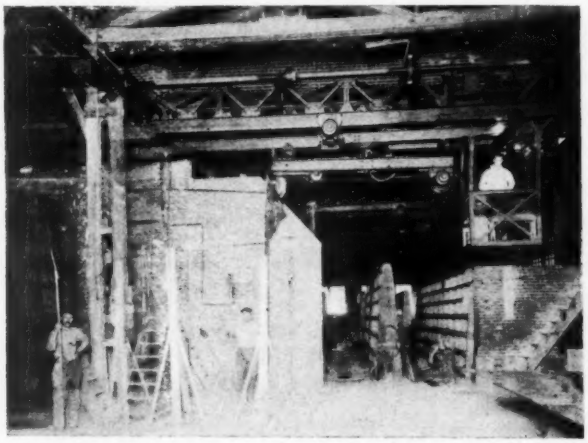

FIG. 6.

duction motor operating at 514 R.P.M. synchronous speed. Several of these motors are shown in Fig. 4.

A typical load curve on one of these polishing motors is shown in Fig. 5, the full scale being 400 KW.

The red rouge for polishing is constantly agitated and is

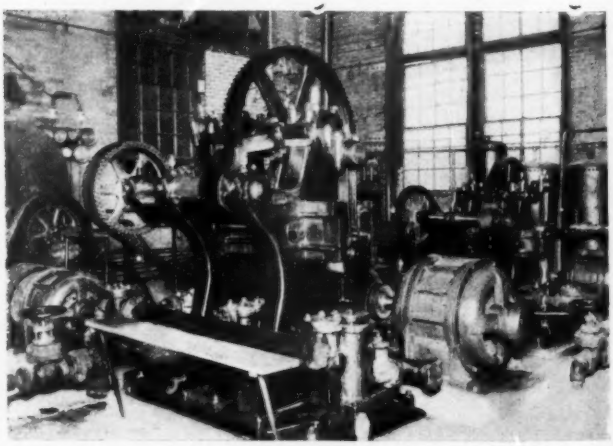

FIG. 7.

mixed in oblong tanks which permit of a thorough mixing. Three such agitators are driven by a 7½ HP., 720 R.P.M. induction motor.

All of the seven grinding and eight polishing machines are rope driven as indicated in the photograph, except one polishing machine which is chain driven. The American system of rope drive is used and has given very satisfactory results.

After the glass has been given a fine polish it is washed

off and taken to the cutting tables, where it is handled by a special type crane, as seen in Fig. 6, which was designed particularly for this kind of service. The plate of glass is carefully examined, all defects noted, and is then cut into proper sizes and placed in the wareroom from whence it is packed and shipped.

Each grinder and polisher motor is controlled individually from a point just in the rear of the grinder and polisher machines. After years of experience it was decided that this was the logical place as it gives each operator instant control of his machine. The control consists of a hand-operated master switch and an automatic control panel which provides for slow speed for a few minutes at the start until full speed is desired.

Quantities of air for raising sand to the grinder tables and for use in the casting hall in blowing off the casting table and

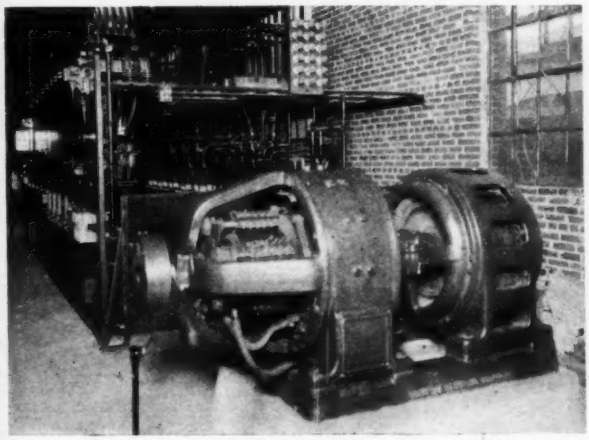

FIG. 8.

opening furnace doors, and so forth, are supplied by motor-driven air compressors.

The heavy circular iron runner discs over each grinding machine require approximately 600 pounds water pressure for raising and lowering them on the glass-grinding tables, and this pressure is supplied by an hydraulic accumulator, which in turn is supplied with water through motor driven triplex pumps as seen in Fig. 7. One of these pumps is driven by a KT.-25 HP. squirrel cage motor, and the other by a KT.-50 HP. squirrel cage motor.

Great quantities of water are required in a glass factory particularly for the grinding tables and for washing off the glass and the floors. This is supplied by three 100 HP., 450 R.P.M. slip ring induction motors driving triplex pumps.

In addition to the above, A. C. motors are used to operate the fire pump, plaster pumps, plaster mixers, carpenter shop, polisher agitators, centrifugal pumps for sand graders, centrifugal pump for emery graders, emery grinders, sand hoist, coal crusher, coal conveyor, casting room pumps, casting room fan, gas producers, machine shop and motor generator sets.

The entire D. C. motor load of the plant is taken care of by one 125 KW., 1,200 R.P.M., 125 volt compound wound synchronous motor generator set seen in Fig. 8, although a 125 KW. induction motor generator set is held in reserve. Direct current is used for the motors on the two transfer cars, which handle the grinding and polishing tables, the power house and casting room cranes, the teeming crane, the special wareroom cranes and the two main lehr motors.

A 28-panel switchboard controls the different circuits throughout the plant. An end view of this board is seen in Fig. 8. In order to show at a glance just how the plant is operating, the incoming line panel is equipped with voltmeter, ammeter, kilo-watthour meter, frequency motor, power-factor meter, curve-drawing kilo wattmeter and curve-drawing power-factor meter. The company at present purchases its power, although in case of emergency they are prepared

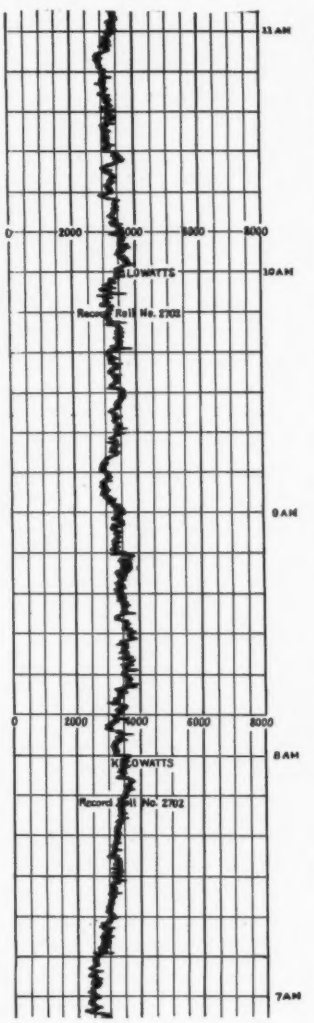

FIG. 9.

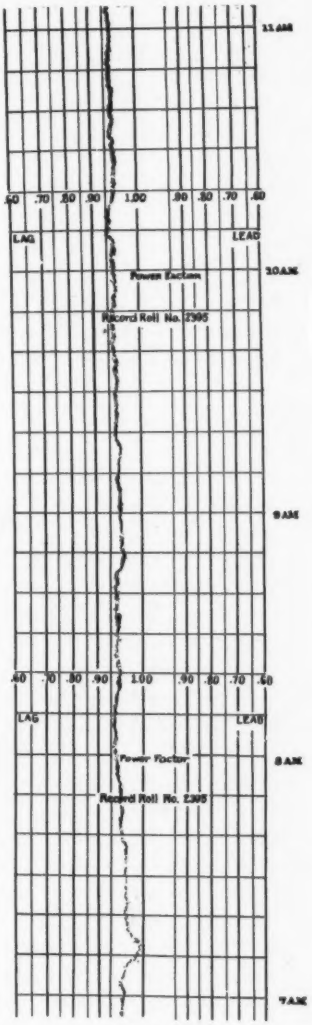

FIG. 10.

to start up their private generating plant and generate a large portion of their requirements. A double bus system with double throw switches permits the operation of any motor circuit either with purchased power or from their private generating plant.

The generating plant consists of three type ATI.-781 KVA., 150 R.P.M. and three type ATI.-500 KVA., 180 R.P.M., 600 volt, 3 phase, 60 cycle General Electric gas engine driven generators. The power is purchased from the Keystone Power Corporation and is transmitted at 44,000

volts, 3 phase, through two lines from the main generating station at Ridgway. A 6,000 KVA. bank of transformers steps the voltage down to 550. The glass plant is in operation 24 hours a day, except Sundays, and the load over the entire period is well represented by the load curve taken from the curve-drawing kilo-wattmeter, as indicated in Fig. 9.

About two years ago the power-factor of this plant varied between 70 and 80 per cent. Since power is purchased on a basis which provides a penalty for low power factor, it was decided to put in a 1,500 KVA., 900 R.P.M., 550 volt synchronous condenser for corrective purposes, and since then the power factor averages more than 95 per cent, as indicated by the power-factor curve in Fig. 10.

The condenser has proven to be a very profitable investment and has been paying large dividends by maintaining a high power-factor.

This plant has recently been purchased by the Durant interests, it being the first independent plate glass factory to change hands in several years, and we believe that their decision to take over this plant rather than any other of the independent glass factories was due largely to the completeness with which it was electrified. The present sixty-cycle equipment has been in operation for about three years, although the plant had been operated for approximately ten years previously by 25-cycle motors of various makes.

This plant has today probably the most complete modern equipment of any of the plate glass manufacturing concerns, and the quality of the glass produced is unexcelled.

The Testing of Glass for Practical Use*

By Dr. Friedrich Spaete†

(Continued from the October issue)

CONDITION OF STRESS.[1]—A good technical glass, which shall not crack at ordinary temperature or upon slight changes of heat condition, must be practically free from internal stress; that is, it must be well annealed and may only have a slight residual stress. The testing for stress is done with the polariscope, which fortunately has already been adopted by many glass factories and which is being manufactured by several firms. Ordinary light is changed into polarized light, for reasons of economy not by using a prism of calc spar (Nichols prism) but by reflection through a plate of glass. A Nichols prism serves as an analyzer. An optical system to obtain enlargement is not needed. A piece of glass which has internal stresses and therefore shows double refraction, is brought in the field between the polarizer and the analyzer. The dark field of vision becomes bright at the parts which are in the condition of stress. The sensibility of the apparatus is increased considerably if a thin red plate of gypsum, called a sensitive plate, is located in the field of vision. The introduction of this plate causes a characteristic interference color. If a thin piece of glass, having only a slight internal stress, is brought into the system, the red color changes to yellow or blue. The intensity of the color change depends on the amount of double refraction, which is a measure of the internal stress. It is best to ascertain by experiment which interference colors are allowable for certain glassware. The piece of glass to be examined should be turned to bring it into different positions with reference to the polarized light. In certain positions no double refraction is observed, even when stresses are present. It should be observed that the amount of double refraction does not indicate the same amount of stress for all sorts of glasses. This is so, because double refraction, caused by stress, depends on the optical elasticity constant, peculiar to each kind of glass.[2] In other words, if glass of the same composition is examined, double refraction can be considered a measure of internal stress. Glasses of different composition cannot thus be compared. The same stress which causes strong double refraction in one glass may cause only a slight effect in another. For practical purposes it is advisable to ascertain which interference colors are an indication of danger. If a quantitative measurement of double refraction is desired a microscope with polarizer and compensator is required.

ANNEALING TEMPERATURE.—For the determination of the temperature at which the internal stresses in glass disappear rapidly, a piece of unannealed glass—for instance a glass cube of 1 centimeter—is heated slowly in a horizontal tube furnace, which is heated by electricity. The cube of glass is observed in polarized light until the stresses disappear. The operation described above is carried out, only with the difference that the glass is gradually brought to a higher temperature. When the internal stresses disappear, the field of vision gradually becomes dark, or, if a disk of gypsum is used the interference colors disappear and the field becomes evenly pink. It is not necessary to use platinum for the winding of the oven, since no high temperatures are attained. Some substitute, for instance nickel-chrome wire, can be used. The temperature is measured with a thermocouple, which need not be made of platinum—platinum rhodium. One of iron-constantan is sufficient for the purpose. The measurement is done with a millivoltmeter. The determination is done best by means of a special microscope, designed by Professor Endell and manufactured by the Leitz Company. This apparatus is provided with a synchronous Nicol prism which can be turned. For this determination the instrument does not require any changes. If such a microscope is not available a tube furnace as described previously can be used. The observation is done

* From *Glastechnische Berichte*, published by the German Society of Glass Technology. Translated by J. B. Krak, Technical Editor of THE GLASS INDUSTRY.

†Director of Research, Osram Works, Berlin.

[1] It is impossible to give here in detail the literature on stress and cooling of glass. The reader is referred to the bibliography on this subject in the chapter "Glass," in Krais, "Werkstoffe," Vol. II., Leipzig, 1921. Of the new American investigations on this subject, the following should be noted:

Tool and Valasek, Bureau of Standards, Scientific Paper No. 358. Peters and Cragoe, No. 393.

Adams and Williamson, Jour. Franklin Trust, Vol. 190, p. 597, 832 (1920).

Littleton and Roberts, Jour. Opt. Soc. Amer., Vol. 4, p. 224 (1920).

[2] F. Neumann. The laws of double refraction of light. Reports of the Royal Academy of Sciences, Berlin, 1841.

with the polariscope. The experiment is carried out in such a way that during observation the temperature is raised by steps of ten degrees, and is kept stationary for five minutes. When the lower limit of the cooling zone has been reached the intensive interference color, visible when a gypsum plate is used, becomes dull rapidly. If the temperature is raised another 10-20 degrees the interference colors disappear entirely and very rapidly.

A knowledge of the annealing temperature is of great importance for the well managed operation of a glass factory. As is well known hot glass objects just from the glass furnace cannot be cooled in the air, since they would develop great internal stresses and would crack. The cooling must be done slowly so that the glass molecules have the opportunity to arrange themselves while the temperature is still high. If the rate of cooling is too rapid the outside layer is already cold and hard while the inner part is still red hot and in a plastic condition. During further cooling the center part contracts and the hard surface layer cannot follow. Thus the glass gets into a condition of stress. To avoid too rapid cooling of glass and to remove any stresses already formed the glass must be transferred to an annealing oven which has a sufficiently high temperature that stresses cannot be formed, or if present can be removed. To maintain the proper temperature of the annealing oven, it is necessary to know the annealing temperature of the glass. This is the temperature at which the mobility of the molecule is such that the glass becomes free from stress. If the glass is then cooled slowly, practically no further stresses occur, It is customary to speak of the annealing range of a glass. At the lower limit of this range the stresses disappear slowly but noticeably. At the higher limit they disappear rapidly. It is advisable to keep the temperature of the oven at the lower temperatures of the annealing range. If the oven runs too high a deformation of the glass objects may take place. They may even melt together. If the temperature is regulated carefully this danger does not exist, because the softening temperature is considerably above the annealing range. However, if the annealing furnace is not sufficiently hot the objects cool too rapidly during the period of the greatest danger of the cooling process, immediately after fashioning the glass. Stresses which are present cannot be removed in spite of the slow cooling in the annealing oven. It frequently happens that objects which show internal stresses must be cooled over again, or must be tempered. Glasses made for special purposes, or glasses which are to be worked before the lamp, must be tempered. In such cases also, a knowledge of the temperature at which stresses disappear is of great value.

The rate of cooling can be computed scientifically but a discussion of the method cannot be entered into. The temperature zone in which the most dangerous stresses occur lies directly below the highest point of the annealing range. In this temperature interval the cooling must proceed very slowly and carefully. In the lower temperature zone the rate of cooling can be increased considerably. In many glass factories errors are committed in this respect, since the cooling is prolonged unnecessarily causing a waste of time and fuel. This does not apply to optical glasses.

In the manufacture of common glassware it is satisfactory to obtain a glass practically free from stresses, that is, one that has only a slight residual stress even when it has been cooled well. Such a slight residual stress is without any danger to the future use of the glass. Optical glasses, however, must be cooled extremely carefully. The rapidity of the cooling depends on the size and wall thickness of the glass objects. Large objects naturally must be cooled slower than small ones. The apparatus described above makes possible the testing of glass as it comes from the annealing oven. Thus it can be determined by experiment how rapidly the cooling can take place without danger of the formation of stresses.

It should be noted that at a temperature below the critical annealing temperature the stresses do disappear, only it takes a correspondingly longer time, which for each degree of temperature can be calculated from data. This is Maxwell's time of relaxation. In practice, however, the cooling is done at temperatures corresponding to the annealing zone, and without danger of deformation except for very thin objects. It is as yet impossible to calculate the cooling temperature and the rate of cooling from the chemical composition. For this reason it is determined experimentally, by the method just described.

CHEMICAL RESISTANCE.—A fairly high degree of resistance against the decomposing action of liquids is frequently required of glass objects. It is impossible to give here all the methods which exist in considerable number for the testing of glass in this respect. Water, hydrochloric and sulphuric acid, sodium and potassium hydroxide, ammonia, sodium and potassium carbonate, ammonium carbonate, etc., are allowed to act on the surface of glass at different temperatures and in various degrees of concentration. The glass in the form of flasks, or as a powder is exposed to the action of the chemicals and the loss in weight is determined. Or the weight of the substance which has gone into solution is determined by estimating the total soluble substances or the soluble alkalies. In general it is advisable to examine glass with reference to the use to which it will be put, for instance chemical glassware for its resistance against chemicals, bottle glass for its resistance against the action of certain liquids, window glass for its capacity to withstand weathering. Finally it should be noted that for an exhaustive study of glass a single method is not sufficient. The behavior of glass with regard to different substances should be studied.

If a rapid qualitative test is required, the methods of Weber or Mylius should be used. According to the former investigator glass objects are exposed to vapors of hydrochloric acid. The latter developed the iodine-eosine method for the testing of glass. The poorer the quality of the glass the heavier will be the white deposit after drying, if the Weber method is used. A dark red coating, deposited on the glass is an indication of poor quality, according to the Mylius test. For the quantitative determination no standard method exists as yet, since the exact estimation gives great difficulty. If glass is to be classified the eosine test of Mylius is recommended.[1] This test is based on the fol-

[1] F. Mylius. The hydrolytic classification and testing of glassware with iodine-eosine. Silicat Zeitschrift, 1913, Vol. 1, p. 2. The alkalimetric testing of glassware. Zeitschrift f. angew. Chemie, No. 50, p. 281, 1921.

lowing principle: The glass is treated with water at room temperature for seven days and subsequently at 80° Centigrade for three hours. The alkali which goes into solution for each treatment is determined. If two glasses are to be compared with one another the simplest way is to have two flasks made of the same size and therefore of the same inner surface. The flasks are filled with distilled water and are heated on the water bath for equal duration—three or five hours—using a reflux condenser. The solutions are evaporated to dryness in weighed platinum dishes, dried in an oven at 105° C., ignited slightly and weighed. Another convenient method is the following: The glass to be tested is powdered and put through a sieve in order to obtain particles of a definite size. After the specific gravity of the glass has been determined a definite quantity, representing a certain volume, is weighed. It is heated for five hours on a water bath in a flask of Jena glass, in which previously water has been boiled for a few days. A reflux condenser is used. The glass is powdered with the object of exposing a large surface to the action of the water and to obtain greater effectiveness. The cooled solution is filtered and a measured aliquot is treated as described above. The total dissolved matter is determined by weighing. If exact results are required, the constituents which have gone in solution are determined by analysis.

Glasses show a different behavior against corroding chemicals, according to whether they are in a condition of stress or whether they are free from stresses. Furthermore the outside surface of a glass object is different from the inside since the former usually is lower in alkali due to the action of the fire. This difference is removed in the method of Mylius, by the preliminary treatment of glass with water prior to making the actual test.

The chemical resistance cannot be calculated from the composition of glass. Certain facts regarding the influence of various glass constituents on the resistance are known. The higher the alkali content, the lower the resistance against water. Silica has an opposite effect. Zinc oxide, alumina and boric acid have a favorable influence. However, glasses which contain silica and boric acid are less resistant against the action of alkaline liquids. As many glass components have an influence in the opposite direction, a conclusion as to the chemical resistance based on the composition should be made with extreme caution.

(*To be continued*)

Glass Decorators' Palette and Its Preparation*

By Theodore Lenchner†

Introduction

Glass may be decorated by use of a color palette or by cutting, etching, engraving or chipping. Low cost glass wares are sometimes decorated with oil paints, the coloring being organic and the decoration not fixed by firing. We will take up only the color palette of glass decorators made with inorganic colors and fixed by firing.

The decorators' coloring materials may be classified into vitrifiable colors (transparent and opaque), stains, gilding and lusters.

Although the materials and methods used in overglaze decorating of pottery and porcelain are similar to those used on glass, the decorating of pottery will not be considered in this series.[1]

Vitrifiable Colors

The manufacture of vitrifiable colors is a highly developed art, especially in foreign countries. In this country their manufacture is comparatively new, but much progress has been made due to the development in chemical science and the increasing control of the raw materials. In fact, certain types of colors manufactured here are superior to those manufactured abroad.

Composition and Preparation

Vitrifiable colors for either glass or pottery are composed of two distinctive parts: The colorant and the flux. The colorant, because of the protracted firing to which these colors must be subjected, consists largely of calcines of metallic oxides, or salts of metals, with clay, flint, zinc oxide or other non-coloring materials. A typical formula of such a stain is 50 per cent alumina, 5 per cent zinc oxide and 45 per cent cobalt. The flux is an easily fusible glass such as

60 parts Red Lead
30 parts Boric Acid
10 parts Silica.

This is thoroughly melted in a crucible and poured into water; then finally ground in a pebble mill. Besides being the medium for fusing the colorant to the glass, the flux assists through chemical influence in producing different colors and tints with the same colorant.

A great variety of fluxes are made, their composition depending upon the character of the colorant to be used, the degree of fusibility desired, and the ratio of contraction and expansion of the glass ware upon which the colors are to be fired.

In the manufacture of the highest grade of colors, the color stain and flux are fused or melted together. These melts are then very carefully ground with water or oil to a very fine or impalpable mass.

In some cases the color stain and flux are merely mechanically mixed by grinding together.

Shades or tints of colors can be produced in a variety of ways. The ancients were experts in mixing colors, for the ancient decorative glass wares which have been unearthed show a variety and wealth of color, some of which have not been reproduced.

The physical properties of these fluxes are not materially

*Journal of the American Ceramic Society, Vol. 6, No. 10 (Oct.), 1923.
†Vitro Manufacturing Co., Pittsburgh, Pa.

[1]Considerable training and experience is necessary to qualify as a master decorator, and in this country too few have taken up this work. It is hoped that in the near future, through the untiring efforts of the art division of the American Ceramic Society, a keener interest will be created in the artistic and decorative development of our ceramic products, and the writer believes wonderful work is being done along this line. When that interest is developed, we shall have many more decorators, not only capable of applying these colors, but also creating designs with greater artistic expression, and this in turn will develop the greater use of vitrified colors.

affected by the added colorant, owing to the small amount of stain added. The color produced, however, depends largely on the composition of the flux and atmospheric condition of the furnace.

The metals employed to produce specific colors are as follows:

Cobalt	Blues-Purples
Copper	Green-Turquoise-Red
Iron	Browns-Blacks-Reds
Manganese	Blacks-Violets
Chromium	Greens-Oranges-Yellows
Nickel	Grays-Browns
Uranium	Yellows
Antimony	Reds-Oranges
Titanium	Cream
Silver	Yellows-Amber
Gold	Pinks-Reds.

Opaqueness may be increased or decreased by varying the percentage of colorant used, or by using white or translucent flux. The so-called matt (dull) colors may be obtained by the use of a more refractory flux.

ENAMELS

Other types of vitrifiable colors used in glass decorating besides the regular decorative color palette are enamels, ices, stains, gold and silver preparations, and lusters.

Enamels contain certain amounts of opacifying chemicals, such as tin and zinc, a typical formula for which would be as follows:

60 parts Red Lead	30 parts Silica
20 parts Fused Borax	15 parts Zinc Oxide.

They are treated same as a flux.

The white enamel is most commonly used in decorating lighting goods glass ware, where a translucent or nearly opaque effect is desired. The thickness with which these enamels are applied determines the degree of opaqueness. The enamels are also used with a colorant where a relief decoration is required.

ICES

Ices are vitrifiable colors which, instead of being finely ground in a mill, are subject to a crushing process after which they are graded into different sizes of particles. Ices produce a very interesting rough surface effect. This type of decoration was formerly much used in lighting goods, but is now being used in decorating tumblers.

APPLICATION

The colors used on glass are fused onto the surface, thus becoming in most cases a permanent part of the glass itself. The "fixing" or fusion of these colors to glass surfaces is accomplished by firing to temperatures ranging from 580° C. to 650° C. depending upon the nature of the glass and color.

The colors are applied by painting, or by spraying with an air machine especially constructed for this work. These processes have largely replaced the old groundlaying process which consisted of an application of finely powdered color to a slightly "tacky" oil ground.

These colors are first thoroughly ground with turpentine in a paint mill to a consistency of cream, or until the color will just stand up. They may also be ground in a pebble mill. A small amount of a slow drying oil, such as Dresden oil or fat oil of turpentine is added in order that the color will not dry too quickly, rapid drying being detrimental.

After application the color is allowed to dry and the ware is then placed in the kiln. The temperature is gradually increased; or if fired in a lehr, the articles are very slowly moved forward toward the center of the lehr where the temperature is the highest.

STAINS

Stains differ from the colors in that no flux is required. These are salts of metals. Instead of being used with the flux, they are mixed with ocher or clay and fired in the ordinary way. These metallic salts impart to the glass their characteristic color in a very clear transparent film.

The writer has knowledge of only two metals whose salts are capable of being reduced: Silver, giving the amber or orange stain, and copper, giving the red or ruby stain. This type of decoration under reducing conditions is very difficult to produce. A typical mixture used is 3 parts calcined yellow ocher and 1 part silver nitrate, thoroughly mixed in a pebble mill. After firing, the ocher may be washed off and the glass underneath will be stained amber.

Effects usually obtained by reduction, which include all the luster decorations (the red or green of copper, green and yellow of chrome, etc.), are hard to control.

GILDING

The metallic gold, silver and platinum decorations are the oldest and most used decorative materials. Their manufacture is quite an art and is successfully practiced by very few concerns. The pure metal is used in powdered form mechanically incorporated with a suitable flux and organic oils and are thus sold in the form of liquid or paste. These preparations are then applied and fired under much the same conditions as the vitrifiable colors.

A liquid, bright gold can be prepared as follows:

5 parts Lavender Oil	1 part Flowers of Sulphur.
5 parts Turpentine	

This is boiled over a sand bath for about one-half hour (according to an old formula). To 8 parts of this thick emulsion is added a solution of gold chloride, which contains one part C. P. gold. This is thoroughly ground together in a mortar with the addition of a small amount of lavender oil. The whole is allowed to stand 24 hours. To this mixture in the mortar is added bismuth subnitrate, equivalent to one-half the weight of gold, and again thoroughly mixed and allowed to stand. This is then taken up in carbon bisulphide, if too thick, and filtered. The whole is allowed to stand on a warm place for 12 hours, after which the solution is ready for application.

LUSTERS

Lusters may be classified as metallic resinates. These are manufactured by slowly adding the metallic salts to boiling mixtures of soluble oils and resins and are thus sold in liquid form. The iridescent effects which impart their characteristic metallic color to the glass surface are not permanent, inasmuch as these lusters do not contain flux, and therefore are not capable of being fused into the glass. Typical yellow luster consists of

1 part Uranium Acetate	5 parts Lavender Oil.
3 parts Rosin	

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CLASSIFIED BUYERS' GUIDE, PAGE 16

Readers of THE GLASS INDUSTRY in the United States and elsewhere are requested to favor the Editor with any information available from time to time concerning developments in their own or other fields which would be of general interest to the industry. Authoritative facts about new glass manufacturing projects, re-organizations, new factory construction, new processes and equipment, raw materials, manufacturing and market conditions, personal items, and other appropriate subjects would be welcomed.

Those experienced in the practical, technical or executive activities of glass manufacturing who are qualified and willing to lend their aid to the upbuilding and progress of the industry by giving from their store of knowledge to others, are invited to submit for publication articles on any subjects relating to glass which would be of interest and value to our readers. The authors of accepted articles of this kind will be compensated at regular rates.

Fuel and Power

The idea to generate power in close proximity to the coal mines and to distribute it from there, rather than carry the coal to distant power stations, is not new. But heretofore it has usually been looked upon as an ideal which could not be fulfilled until perhaps in the far distant future. The realization of this thought has been brought considerably nearer by the efforts which are now being made by the engineer-statesman at the head of the Department of Commerce, Herbert Hoover. His recent statements regarding the superpower area idea have created widespread discussion among engineers, manufacturers and all those who realize that our future development as an industrial nation is dependent upon rational distribution of every available unit of fuel and power.

The possibility of transporting high voltage current for long distances with only slight losses has made possible the development of water power hitherto considered as out of the question. According to the official estimates the saving to public utilities, railroads and industries will amount to nearly five hundred million dollars annually, if the superpower idea can be made a reality.

That the successful working out of this project will be of great benefit to the glass industry is quite evident. In the first place it is the only means of checking the constant rise in the cost of fuel. On the other hand, it will make available at a reasonable figure an abundance of electric power, which will be used in ever increasing quantities as the glass industry develops.

The power development plans of Secretary Hoover deserve the whole-hearted support of every industrialist. But it will take more than approval to translate thought into action. It is felt that the leading men of the glass industry in common with others of the industrial world will give active support to whatever measures may be taken as a result of the far-seeing statesmanship of our Secretary of Commerce.

Drinking Glasses Versus Paper Cups

The agitation now on foot in certain quarters to abolish the use of drinking glasses in all public places, including restaurants, cafes, and ice cream parlors, has a similar origin as certain laws now on the statute books, to make the majority conform to the views of a small and bigoted, but active and well organized minority. These laws, which are not without a modicum of sense, and for which some argument can be advanced, have become farcical because they have gone far beyond the purpose for which they originally were intended. As a result we have become from a law-abiding people a nation of law-breakers, showing a disrespect of authority which is truly alarming.

It is agreed that the use of the paper drinking cup is admirable in its place. Wherever the rinsing and cleaning of a drinking glass is impossible the paper cup is the proper solution of a problem in hygiene. Paper cups, like paper plates and paper napkins, are very convenient for a picnic. But why in the name of common sense there should be need for a law forcing us to use paper cups when for all practical purposes glassware is better, is a question which the average mind is unable to answer.

To all unbiased observers it is clear that a paper cup is a substitute for glass. But why should a substitute become generally accepted as long as a better and more satisfactory article exists? If restaurants, cafes, and ice cream parlors are forced to use paper cups for hygienic reasons, why is it that they are allowed to continue the use of china ware, knives, forks and spoons? These articles are as apt to carry germs as a glass, which through its high polish can be cleansed thoroughly and which magnifies every particle of dirt present.

Glass makers and all those interested in the adoption of sane laws will oppose the addition of another oppressive and ridiculous measure to the statutes of the nation.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Questions should be submitted in writing and will be answered by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question 54. Potassium nitrate as a substitute for sodium nitrate in flint glass lamp chimneys.—We have a friend who is making flint glass lamp chimneys and is using sodium nitrate. He understands that potassium nitrate is cheaper and wishes to know if he can use this equally well in his formula.

Answer.—With regard to the substitution of sodium nitrate by potassium nitrate, we should like to suggest that it is very unlikely that the latter substance can be obtained at a lower price, except in unusual cases.

Nitrates are used in glass only in small quantities, and on account of the oxidizing action of the nitrate. It makes no difference whether this nitrate is combined with sodium or potassium and your friend can safely substitute one for the other, especially since the coefficient of thermal expansion of potassium oxide is smaller than that of sodium oxide. It should be noted that the molecular weight of sodium nitrate is 85 and that of potassium nitrate is 101. Therefore, if the latter is used, it is necessary to multiply the amount of sodium nitrate by $\frac{101}{85}$ in order to obtain the equivalent amount of potassium nitrate.—J. B. K.

Death and Destruction in Japanese Factories

Heavy damage to the glass factories of Japan was done, and numerous fatalities among men engaged in the industry resulted from the great earthquake. A letter just received from a subscriber, K. Ishikawa, tells briefly of the destruction wrought at the glass works of the Tokyo Electric Company, Inc., with which he is connected. Part of Mr. Ishikawa's letter follows:

To the Editor of THE GLASS INDUSTRY:

I have received your letter and give you warm thanks for your kindness to us at this time of tremendous events. . . . . .

It has been very unfortunate for our glass industry. Most of our glass factories are destroyed. Iwaki Glass Works, Samphosha refractory works, already you knew are fired too. In our company No. 13 and No. 25 buildings fell down. Just at that time, the glass engineering conference was being held at No. 13 building and Mr. T. Ohba, Mr. T. Kumagai, and Mr. T. Okagi, important glass engineers, were killed. Mr. K. Kato, manager of engineering department, Mr. T. Fujii, director of research laboratory, Dr. S. Ohhashi and several other important engineers were killed at the same building. At that time I was just out of the room with other business, so could barely escape.

We lost about 100 thousands of men in one night. We shall work so much harder to make up what is lost.

As a Japanese, I again thank you and all Americans showing kindness to us, through your GLASS INDUSTRY.

Very truly yours,
K. ISHIKAWA.

Public Health and the Soda Glass

Widespread discussion has been going on throughout the trade over the action taken by the Board of Health of the City of New York, which late in the Summer issued orders prohibiting the use of glass tumblers or other glass containers at street stands conducted by certain dispensers of "soft" drinks; and authorizing the use of paper containers at these places. Considerable feeling was aroused among glass manufacturers who believe the action of the Board of Health and similar incidents in other communities, to be unwarranted discriminations against the use of glassware and a menace to the future of the glass manufacturing industry. In some quarters it is believed that prejudice against the use of glass containers in public drinking places has been fostered by the propaganda of paper cup manufacturers, although no evidence on this point has been forthcoming.

Protests against the order of the Board of Health were made by the American Association of Flint and Lime Glass Manufacturers, and a meeting of the manufacturers was addressed by Judge I. G. Jennings, director of the Glass Container Association, whose remarks, as reported in *The Glass Container*, of September, 1923, were in part as follows:

It is undoubtedly the case that in a public place where there is no means of washing or properly cleansing a common drinking glass which may be used over and over again by thousands of people that the enforced use of paper cups or single service containers may properly be defended as in the interests of public health. Here, then, is one of the many important and indisputable fields for the paper container, and there is no disposition on the part of the manufacturers of the glass container to oppose this very proper type of regulation in the interests of public welfare.

But what the glass manufacturers do object to is that progressive, sentimental guff which, if not checked and exposed, might drive from general use the cleanest, safest, and most healthful container when properly cleansed, in the possession of the human race. Therefore, it is with the interests of public health in mind that the glass manufacturers wish to say a few words for the soda glass or any other glass container that is used in drug or confectionery stores and in public stands and places for the service of drinks, beverages, or frozen confections where it is possible to maintain proper cleansing facilities for the glass container after each use.

Without attempting to state what may be behind it all, it is a fact that in a legislature here, in a city council there, or a health board at some other place, there have been attempts to compel the use of the paper cup and the elimination of the glass container from places where drinks and beverages were served. These attempts have universally failed, but so far as they have been made by sincere men and officials in the interest of the public health and welfare, we desire most earnestly to present the reasons why such a movement on their part is directly against that public welfare which they prize so much, and we hope that they will just as earnestly consider the arguments we make.

The glass container manufacturers want to be rightly understood in this matter. We believe that it is a proper function of the boards of health and other regulatory bodies to compel the proper use of the glass container in public places. No one should be required nor permitted to use a dirty glass container or one that has been insufficiently cleansed. Glass is intended to be washed, cleansed or sterilized according in degree to the use to which it is put, and it is largely due to the fact that glass will permit of any degree of cleansing and sterilization that science itself has made its tremendous progress with the years.

There should be a hearty co-operation then between the manufacturers of glass containers, the retailers of beverages, soda water and other drinks, and boards of health,

and other regulatory bodies, in giving to the public a thoroughly clean glass container, and to acquiesce in any inconveniences and expense made necessary thereby. We believe that such co-operation can easily be brought about.

Let us, then, examine and properly appraise the situation in the interests of public health, weighing the case of the glass container against the paper cup, to consider whether the reasons so glibly suggested by those who favor the paper container, are as adequate and complete as they would have us think. In other words, much has been said and advertised on the one hand. Let us in the spirit of fairness hear from the other side.

Shall we condemn the public to use the squashy paper cup that no scientist has ever decreed to be more sanitary than a clean glass? No scientist would make such an absurd statement. Indeed it might be quite a difficult thing to prove the respectable paper cup to be as sanitary as its reputation. A reputation given it by wide advertising and effective propaganda.

Paper is made of wood-pulp, of old paper, rags, and various materials that are anything but clean. These materials are supposed, in the metamorphosis from refuse to paper and paper cups, to become completely sterile and sanitary. Perhaps—

But cannot a paper cup collect dust as does the glass? Granted, it certainly collects as much—this must be logically true. But dust cannot be detected on a paper cup—for it cannot show by contrast. A speck of dust on a glass is instantly seen. The sparkle of the glass magnifies it, and that bit of dust sticks out like a sore thumb. The dirty glass can be instantly washed, and completely sterilized. It can be made a single-service container by means which science has devised, and law has adopted. No amount of regulation can ever guarantee a like purity in the paper cup. There is without any doubt a certain amount of dust pollution when the paper cups are exposed to the conditions of packing and transfer from the machine or hand that makes them to the retailer, and when the paper cups are once in the hands of the retailer there is immense opportunity for dust-catching—even if exposed to the air of public places for just a few minutes.

Who has not seen a stack of paper cups exposed, the top cup of the pack open to all the dust in the air, in which, we are told, there are so many desiccated germs, invisible but none the less harmful. The lips of all the other cups in the pack are equally exposed. And when the top cup is used, its place is taken by the container beneath. Is this sanitary? and is this the protection that is to be forced upon the public in the name of health and sanitation?

Paper cups, in the beginning were designed as substitutes for glass—in places where proper washing of glasses would not be practical—such as picnics, ball games, outings, and on movable stands and the vehicles of venders. It was impractical to use glass here, however great the desire of the public was to have it used. And so paper was substituted. Shall the substitute be forced upon an unwilling public in places where it clearly should not be used?

The glass container, when it is used, can be thoroughly washed; and it is a simple thing to wash it, making it the scientific ideal of single-service containers. The paper cup cannot be washed effectively. The pollution it may contain must remain in it, and become a part of the food or beverage served in it. The glass container is smooth; its surface does not hold dust and germs. The paper cup, by a process of its making, contains folds that makes wonderful hiding places for dirt and dust. They cannot be seen there, and so the cup may appear clean, and at the same time be unsafe for use.

The paper container has been, in some States, insisted upon for use in the schools and with a discouraging result. It was hoped to do away with the dangers of the common drinking cup by that means—but in the rural schools it resulted in a worse condition, if possible, than resulted from the far-famed common drinking cup. The State would find it inconvenient, either from lack of appropriation, or from some reason of administration, to supply the schools with the enormous quantity of paper cups necessary for the real use of the pupils; so when the supply ran out, the pupils hoarded their used paper cups in corners of their desks, in dirty shelves, entry ways, and any convenient hiding places, and would use these cups for weeks at a time, until they were so battered that they would not hold water, and so dirty that they were vile to look at, and horrible to think of. This is what the use of the paper container amounts to in the rural schools—it is ludicrous to think of as a sanitary measure!

There is a very deep psychological reason why people dislike the paper cup—a reason which lies in the fact that the paper cup is not transparent. One cannot have the pleasure of seeing the sparkling beverage, or enjoy its fine color and charming effervescence. How much pleasanter to drink a sparkling water from a sparkling glass than to drink the sweetest, finest beverage from a paper cup! Half the joy of drinking comes from the pleasure of seeing and enjoying the color and purity, the limpid life and clarity of the beverage—shall this harmless joy and pleasure be legislated out of existence?

There is no container more sanitary than the glass container; it is capable of complete sterilization, and a cleansing thorough enough to live up to the requirements of any sanitary ideals, no matter how rigid and austere. The emphasis should be placed upon enforcing proper cleansing. Then will the public be truly protected; and then will the public be really grateful, knowing that they are protected, and yet not forced to endure nameless inconvenience and dissatisfaction.

But this much is certain: That as a panacea for a hypothetical menace to health that has as yet never been proved, and upon which there is no substantial evidence at all, namely the danger to public health at soda fountains, the paper container is not the answer. If such danger exists it can be met by public officials properly enforcing regulations for clean glasses and the co-operation of the retailers of drinks and beverages in observing these regulations made and enforced both in the public interest and their own.

The Soda Glass vs. the Paper Cup

1. There is no way of telling what may happen to the paper cup from the time of manufacture to the time of use.

2. The paper cup collects dust in retailers' stores before using.

3. The lip of the cup and the folds in the cup are splendid dust catchers. Dust cannot be seen on the paper cup.

4. There is no way of washing or cleaning a paper cup before use.

5. After all, it is generally the spoon that goes in the mouth, and where there are no facilities for thoroughly washing glasses, the washing of spoons is apt to be neglected.

6. The paper cup leaks, squashes, and is unhandy and precarious to use.

7. Ice cream sticks to the side and is liable to spill on good dresses. Drinks are apt to run down the sleeve.

8. Half the joy of drinking beverages is the ability to see the sparkling liquids through the sparkling glass.

9. The public prefers the glass container. It is substantial. There are no foreign tastes or flavors.

10. There is a tendency to rinse the paper cup. This is the height of unsanitation by reason of the nature of the cup. Paper is porous; glass is not.

11. The paper cup is expensive. It is thus a tax on the public. This would amount to millions of dollars in a year. This would be a great injustice.

12. Retailers know this and object to the additional expense. If they are forced to use paper, they will transfer the cost to the public.

13. The paper cup was originally a substitute for glass where glass could not be used. Shall the substitute displace the real thing?

14. No record of epidemics is traceable exclusively to glass at soda fountains.

15. No record of epidemics is traceable exclusively to dishes, knives, forks, or spoons at respectable hotels.

16. No record of epidemics is traceable exclusively to dishes, knives, forks, or spoons at homes.

17. The logic of the thing under a paper regime is unthinkable.

18. The use of paper cups as a panacea for this supposed menace would breed misplaced confidence by retailers, by public officials. The public would suffer.

19. If any danger, remedy lies in enforcing cleanliness and cooperation between glass men, dealers and boards of health.

20. The difficulty of administration of rules requiring cleanliness is no excuse. To eliminate the glass container would be a taking of property without due process of law, and thus unconstitutional.

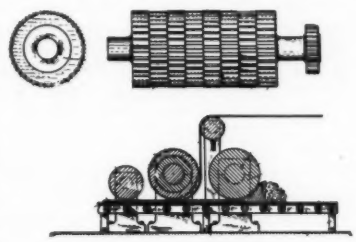
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Apparatus for Making Wire Glass. U. S. 1,466,025. Aug. 28, 1923. Noah A. Liston, of Glassport, Pa.

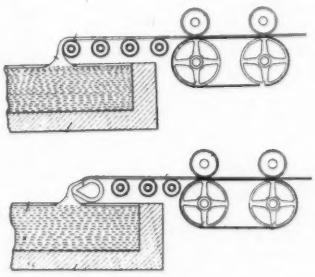
Heretofore in the production of wire glass, apparatus has been employed comprising rolls in the peripheral face of which continuous corrugations or serrations were formed, which embedded the wire or wire netting in the glass in continuous or uninterrupted lines of wire transversely of the sheet, which frequently produced dark colored lines, due to the fact that a large portion of the glass was subjected to the action of the roll and frequently caused oxidation of and around the embedded wire.



The object of this invention is to produce an apparatus which will embed the wire in interrupted or staggered lines and substantially eliminate the objectionable feature heretofore herein mentioned.

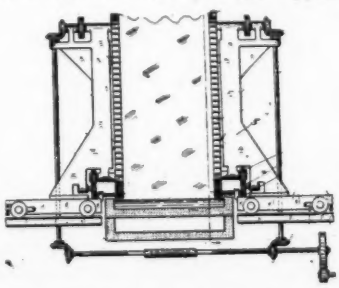
Method of Making Sheet Glass. U. S. 1,469,382. Oct. 2, 1923. Joseph P. Crowley, of Toledo, O., assignor to The Libbey-Owens Sheet Glass Company, of Toledo, O.

The object of this invention is to draw sheet glass free from the blemishes, burn, impressions, unequal skin tensions, and other defects caused by drawing and bending a sheet of glass over a roll when the sheet has lost its elasticity to such an extent that it is susceptible to defects that cannot be removed after it is in a horizontal plane. The method consists in drawing hot glass from the upper surface of the molten mass over a cooled deflector adjacent the surface of the mass, and then extending this hot plastic glass horizontally into sheet form before it cools sufficiently to lose its plasticity.



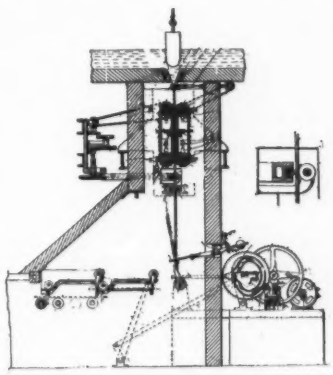
Drawing Continuous Sheet Glass. U. S. 1,469,380. Oct. 2, 1923. Robert P. Callard, of Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Company, of Toledo, O.

This invention is concerned particularly with a process for drawing the sheet by means applied only to the side edges thereof, leaving the central body portion of the sheet entirely free and exposed throughout the drawing process. The inventor claims in a sheet drawing machine, a receptacle containing molten glass from which the sheet is drawn, means for engaging and moving with each edge of the sheet until the sheet has become set for drawing the sheet from the receptacle, pairs of edge forming rollers engaging each edge of the sheet between the molten glass and the edge drawing mechanisms, and means for simultaneously and synchronously driving the two edge drawing mechanisms, the edge forming rolls being driven from the same source.



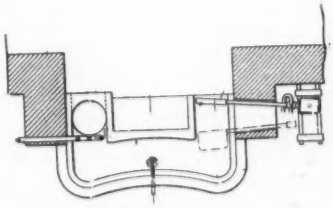
Sheet-Glass-Drawing Mechanism. U. S. 1,469,379. Oct. 2, 1923. Robert P. Callard, of Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company, of Toledo, O.

The invention broadly consists in providing a long slot or opening in the bottom of a glass-melting furnace, or the fore-hearth thereof, through which molten glass flows in sheet form in juxtaposition to suitable temperature regulating devices for regulating the temperature of the molten glass, combined with width-maintaining devices and gripping or drawing mechanism to apply drawing power to the sheet, said mechanism acting in a vertically downward direction. After the sheet of glass passes the gripping mechanism which applies drafting power thereto, it is automatically acted upon by a transverse scoring device and is then received by a suitable carrier which operates to sever or break the sheet along the scored line while still in a substantially vertical position, and then to lay the severed sheet upon a transfer carriage, which automatically delivers it to the lehr.



Manufacture of Glassware. U. S. 1,469,457. Oct. 2, 1923. Robert Good, of Washington, Pa.

The inventor claims in an apparatus for making articles of glass, a furnace or tank, a channel for the molten glass communicating at both of its ends with the main body of molten glass in the furnace, a reciprocating paddle in said channel, the paddle being arranged to engage and push the glass in the channel with its flat side during its forward stroke and to turn on its axis during its back stroke to feather over the top of the glass.



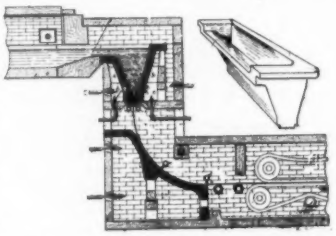
The invention also consists in the shape of the trough, the furnace breast arrangement, the means for causing the flow of the glass, as well as in the construction and arrangement of parts.

Gas Producer. U. S. 1,469,399. Oct. 2, 1923. Francis H. Treat, of Cleveland, O., assignor to Duff Patents Company, Inc., of Pittsburgh, Pa.

One of the objects of this invention is to provide a gas producer in which the usual grate construction is eliminated and to provide in lieu thereof an arrangement of blast distributing tuyeres which, the inventor claims, are so constructed and arranged as to impose a minimum resistance to the descent of the ash and fuel bed in the producer, while at the same time they give an effective distribution of the blast throughout the fuel bed.

Method of and Apparatus for Producing Continuous Sheet Glass. U. S. 1,469,383. Oct. 2, 1923. Joseph P. Crowley, of Toledo, O., assignor to The Libbey-Owens Sheet Glass Company, of Toledo, O.

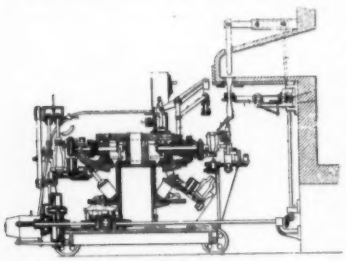
The failure of previous attempts to flow glass downwardly through a slotted former, have been largely due to the tendency of the hot glass to adhere to the walls of the container, and the sides of the slot, and as this glass cools it forms so-called "dog-metal," which obstructs the opening and causes lines and other defects in the sheet. In the present invention, the above difficulty is largely obviated, by forming the slotted hopper or receptacle, through which the molten glass flows into sheet form, of graphite-clay or a similar composition, to which the hot glass will not adhere, but over which it freely slides without injury to the surfaces of the molten glass as it takes sheet form. The invention also provides a device of graphite clay for directing the downwardly moving sheet into a horizontal plane, for convenience in flattening and further handling.



Glass-Feeding Mechanism. U. S. 1,470,023. Oct. 9, 1923. Edward Miller, of Columbus, O., assignor to Chapman J. Root, of Terre Haute, Ind.

This invention relates to mechanism for enabling glass to be fed automatically from the spout of the glass tank into the mold of a glass-making machine.

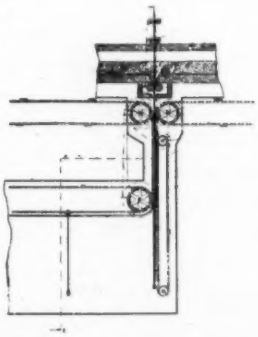
The chief improvement consists in combining with the glass machine a spoon-shaped trough-like member, the bowl of which is directly under the discharge outlet of the spout and the remainder of which extends downwardly at an inclination towards the mold in such position that when the gather of glass is severed, the glass will be guided and automatically descend to and into the mold.



Method and Apparatus for Forming Sheet Glass, U. S. 1,471,189. October 16, 1923. Hubert A. Myers, of Toledo, O., assignor to the Hubert A. Myers Company, of Toledo, O.

A method and apparatus for drawing or flowing a continuous sheet downward from a tank or other source of molten glass supply, applying frames in successive order thereto to prevent distortion of the portions of the sheet encompassed thereby, and subsequently separating the sheet between the frames into sections for annealing and separate handling.

Among the inventor's claims in an apparatus for forming sheet glass, is a tank having an opening in its bottom from which molten glass may flow in sheet form, means forming a lehr subjacent to the tank and a vertical passageway in communication with the tank opening, means for feeding successive edge strips in pairs to the side edges of a sheet as it flows from the tank, means for applying cross bars successively in pairs to the upper and lower ends of each pair of edge strips and the interposed sheet section to co-operate with the edge strips to form sheet embracing frames, means for guiding and moving the framed sheet sections down through the passageway and into the lehr, and means for engaging edge sheet section embracing frame when in the lehr to move it laterally from the succeeding framed section to sever the sheet therebetween and to carry the severed section through the lehr.



Paste for Etching Glass. U. S. 1,470,772. October 16, 1923. Leo Simon, of New York, N. Y., assignor to Henry L. Greenbaum, of New York, N. Y.

This invention relates to an etching material in the form of a paste and which may be rendered thick or thin, strong or weak, as desired. It is claimed to be safe and well adapted for use in frosting incandescent bulbs, in lettering bottles, in the preparation of glass signs, and in practically any relation in which an etching material is ordinarily used and is especially adapted for enabling incandescent lamp bulbs to be etched quickly and thoroughly by dipping them bodily into the paste.

It contains ammonium sulphate, hydrofluoric acid and liquid mucilage.

Business Publications Received

Brown Electrical Indicating and Recording CO_2 Meters. Catalog No. 30. The Brown Instrument Company, Wayne Station, Philadelphia, Pa. An 8-page pamphlet containing a general discussion of electrical meters for the measurement of CO_2 content and temperature of flue gas, explaining the principle of operation and giving information on the installation, operation and maintenance of the Brown CO_2 meters.

Quigley Insulating Brick and "Hytempite." The Quigley Furnace Specialties Company, 26 Cortlandt street, New York, has issued a 16-page booklet describing the important benefits derived from insulating the walls of lehrs, recuperators, gas producers, boilers and other structures and giving facts concerning Quigley Insulating Brick and the savings effected by the use of them.

Another booklet issued by the same concern is devoted to "Hytempite," the well-known high temperature fire brick cement, and contains valuable information on the proper methods for using it with crushed fire brick for furnace walls, baffles, and for repairs to fire brick construction in general.

Air Compressors. The Ingersoll-Rand Company, 11 Broadway, New York, has just issued a new 36-page bulletin describing their "Imperial" type XPV steam driven air compressors. This type of compressor is built in a number of different types and sizes. Standard two-stage machines for 100 pounds discharge pressure, range from 246 to 4,150 cubic feet per minute piston displacement. Single-stage compressors are built for furnishing air up to 50 pounds discharge pressure. These machines may be obtained in any of the following arrangements: Simple duplex steam cylinders and single-stage duplex compressing cylinders; simple duplex steam cylinders and two-stage compressing cylinders; compound steam and two-stage compressing cylinders; compound steam and single stage duplex compressing cylinders.

Chemical Engineering Catalog. Eighth annual edition. 9 by 12 inches, 1049 pages. Published by the Chemical Catalog Company, New York. Price $2.00; in foreign countries, $3.50.

Nearly 200 pages of this well known and useful publication are devoted to a classified cross-referenced index to manufacturers and dealers in equipment, machinery, heavy and fine chemicals, laboratory supplies and raw materials used in the chemical industries. Following this is a section of 738 pages devoted to condensed, standardized catalog data of equipment and supplies offered to the chemically operated industries by several hundred different manufacturers. At the back of the book is a section of nearly 100 pages devoted to cataloging books in English on chemical and related subjects. The Chemical Engineering Catalog is intended as a standard work of reference for chemical engineers, works managers, purchasing agents, operating engineers and others who specify and buy equipment and materials in the industries using chemical processes.

The Glass World and What It Is Doing

News of the Industry

Publicity for Illuminating Glassware

A splendid example of co-operation among manufacturers to develop a larger market for their products is found in the advertising campaign now under way for the Illuminating Glassware Guild.

Manufacturers of lighting glassware have established themselves firmly, as regards the commercial and institutional lighting field, but the manufacturers of lighting fixtures have shown considerable apathy regarding the use of glass shades in residences. The advertising campaign of the Illuminating Glassware Guild is designed to overcome this attitude on the part of the lighting fixture manufacturers, show them the superiority of glass-shaded lights and provide them with facts regarding the sales possibilities of the field, and a practical plan for increasing their sales.

The advertising campaign began with an introductory four-page announcement in the August issues of *Electrical Record, Electrical Merchandising,* and *Lighting Fixtures and Lighting.* In the September number of these magazines a handsome twelve-page insert in colors sets forth the whole scheme developed by the Guild. The dealer's opportunity in the field is described, the plan for co-operation between manufacturer and dealer is outlined and the selling factors involved are described. Handsome color plates illustrate illuminating ware of various designs made by member firms of the Guild including: Gillinder Brothers, Port Jervis, N. Y.; Gleason-Tiebout Glass Company, Brooklyn, N. Y.; H. Northwood Company, Wheeling, W. Va.; Ivanhoe-Regent Works of General Electric Company, Cleveland, O.; Jefferson Glass Company, Follansbee, W. Va.; Macbeth-Evans Glass Company, Pittsburgh, Pa., and Phœnix Glass Company, Pittsburgh, Pa.

The Guild analysis of the market awaiting dealers is based on the number of shadeless sockets in the 8,267,000 homes in the United States now wired for electricity, and the estimated number of additional dwellings (1,231,000) to be wired during 1923.

These figures are given in the advertising copy:

The National Market

Wired homes in the United States at the end of 1922	8,267,000
Total number of sockets	181,874,000
One-half of these sockets need glass	90,937,000
Estimated number of homes to be wired by the end of 1923	1,231,000
Additional sockets to be shaded by glass	27,082,000
Total potential market for residential lighting glassware, end of 1923	118,196,000

The Local Market

Population of Jasper, Ind.	2,359
Number of electrical dealers in Jasper	2
Number of homes	564
Number of wired homes	500
Number of sockets	11,000
Number of sockets requiring glass shades	5,500
Possible sales of residential lighting glassware per dealer, not counting homes wired in 1923	2,750

In connection with this campaign of the Illuminating Glassware Guild, it is interesting to note that the National Council of Lighting Fixture Manufacturers recently adopted the slogan, "Notice the Lighting Equipment," and is engaged in raising a fund of $300,000 to further the use of the slogan and advertise the products of the members of the Council. It is the purpose of the Illuminating Glassware Guild to impress upon these fixture manufacturers the superiority of glass shades over those made of other materials, to the end that their advantages shall be given full recognition by the lighting fixture manufacturers, the dealers and the public.

Progress in Owens Bottle Case

What was believed to be concluding evidence in the case of the Federal Trade Commission against the Owens Bottle Company, Toledo, O., which is accused of restraint of trade, was taken early in October before John W. Bennett, Federal trade examiner, at Philadelphia, Pa.

The investigation is being conducted on the complaint of the Commission, which charges the bottle company with the violation of the section of the Clayton act which provides that no corporation engaged in commerce shall acquire the capital stock of another corporation engaged in commerce where the effect of such acquisition may be to substantially lessen competition between the corporation whose stock is acquired and the company making the acquisition, or where it may tend to create a monopoly in any line of commerce.

It has been shown that the Owens Bottle Company acquired the capital stock of three corporations: Whitney Glass Works, Glassboro, N. J.; the American Bottle Company, Streator, Ill., and the Graham Glass Company, Evansville, Ind.

After the taking of all testimony, briefs will be filed, final arguments heard, and the case taken under advisement by the Commission.

Patent Decree Clarified

A supplemental opinion to one last year in the case of the Macbeth-Evans Glass Company, plaintiff, appellant, versus L. E. Smith Glass Company, from the Pittsburgh district, was filed October 3, by Judge Davis, in the Circuit Court of Appeals. The bill related to alleged infringement of the Macbeth-Evans lens. Judge Evans found that the lens of the defendant combined all the elements of the plaintiff's lens, operated in the same way and produced the same results. The supplemental opinion said:

"No one doubted that the defendant's lens was a plain infringement, if it was valid. Below, validity of the patent was the principal issue. It seemed unnecessary to the District Court to pass upon the question of infringement after holding the patent invalid.

"We reached a different conclusion as to the validity," Judge Davis said, "and it was an oversight that we did not include in our former opinion and decree that the defendant had infringed the patent."

A corrected decree as of the date of the original decree, and also a corrected mandate in accordance with the decree, was ordered to be issued to the District Court.

New Device for Lehrs

An improvement relating to conveying machinery used with lehrs is announced by McCamic-Batchell-Bergman Company, engineers and contractors, Toledo, O., who report that they have developed in connection with the Automatic Machinery Company's carrying-on device an efficient heating chamber immediately in front of the lehr pans, forming part of the fire box and thus extending the hot zone inside the lehr several feet, not only meeting conditions existing where the conveyor of the Automatic Machinery Company is installed, but also where any other type is employed. The device they state, will even give beneficial results in a lehr where the ware is carried in by hand.

The heating chamber is brought into direct connection with an ideally arranged combustion chamber which is underneath the pans, but it also can be installed on any type of lehr "where the combustion chamber is installed against nature's principles," by making the front heating chamber independent of the lehr fire box proper.

American Window Glass Annual Report

At the annual meeting of stockholders of the American Window Glass Company on October 16 the present directors were re-elected and W. L. Munro, president, presented his annual report, summarized below:

Net profits from operation		$5,012,807.01
Other income		691,148.17
Total income		$5,703,955.18
Deductions from income—		
Res. for taxes	$411,249.23	
Royalty	2,403,487.89	
Other charges	131,662.71	
		2,946,399.83
Surplus for year		$2,757,555.36
Surplus, Aug. 25, 1922		7,905,944.35
Total surplus		$10,663,499.70
Deductions from surplus:		
Dividends on capital stock		279,640.00
Surplus Aug. 31, 1923		$10,383,849.70

The consolidated balance sheet of the American Window Glass Company, the American Photo Glass and Export Company, and the Western Pennsylvania Natural Gas Company, for the period ended August 31, 1923, was issued, as follows:

ASSETS

Cash, notes and accounts receivable, less reserve for doubtful accounts	$1,589,775.75
U. S. Liberty bonds and treasury certificates	4,073,900.00
Finished product, materials and supplies	3,512,022.72
Deferred charges	79,917.76
Plants, real estate and good will, less reserve for depreciation	20,917,892.61
Investments	18,267.21
Treasury stock	5,000.00
Total	$30,196,776.05

LIABILITIES

Accounts payable for materials, wages, etc.	$563,863.92
Preferred stock dividend, payable Sept. 1, 1923	140,000.00
Royalty payable	661,573.25
Reserve for taxes	1,327,770.87
Prepaid royalties	119,718.31
Preferred capital stock	4,000,000.00
Common capital stock	13,000,000.00
Profit and loss-surplus	10,383,849.70
Total	$30,196,776.05

Oil Burner Manufacturers Form Association

The American Association of Oil Burner Manufacturers, a national organization of both home and industrial oil burner manufacturers, was recently formed in Chicago. Broadcasting accurate data concerning oil burning and the oil burner industry is one of the Association's principal aims. Wallace C. Capen, Home Appliance Corporation, St. Louis, was elected president, and Leod D. Becker, editor of *Fuel Oil for Heat and Power*, Galesburg, Ill., was made acting secretary. Temporary headquarters will be maintained at 518 Bank of Galesburg Building, Galesburg, Illinois, and Room 605, 20 E. Jackson Boulevard, Chicago.

A New Blowing Machine

The Miller Machine & Mold Works has announced a newly designed machine, known as model "M," with 8 molds for wide mouth or semi-wide mouth ware, such as milk bottles, jars, globes, shades, etc. It is strictly automatic, having an automatic transfer and take-out, eliminating the taking-out boy. It is a single table machine, with molds mounted alternately and is very similar in design to their model P-B combination machine, with a built-in wind system and equipped with mold cages so that old molds can be turned down to fit the cages. The machine can be seen at the factory, 705-719 Ann Street, Columbus, Ohio.

Northwest Needs a Container Factory

Local consumption of imported glass bottles in the fruit juice, canning and milking industries calls for a well organized glass plant somewhere in the Northwest, according to Hewitt Wilson, 6822 Eighteenth Northeast, Seattle, Wash., professor of ceramics in the University of Washington College of Mines. Pure quartz for manufacture of glass, according to Professor Wilson, is available at Merritt, Denison, Buckeye, and Clay City, Washington, near Ketchikan, Alaska, and Moscow, Idaho. High silica sandy clays can be secured in the Green River Valley, Professor Wilson says.

Manufacturers Association Asks Charter

The Associated Glass and Pottery Manufacturers, organized to protect trade and commerce in glassware and pottery and to educate the public in the benefits of their uses, filed an application on October 16 in the common pleas court at Pittsburgh, Pa., for a charter. The signers of the application include: Charles H. West, D. Harry Cushwa, Earl Wasson of Pittsburgh, Pa.; Kirk Bryce, Mt. Pleasant, Pa., Harry A. Ross, Pittsburgh, Pa.; J. M. Harmon, Bellevue, Pa.; J. C. Ashbaugh, East Liverpool, O.; Charles L. Sebring, Sebring, O., and George T. Brush, Zanesville, O.

American Ceramic Society News

The next annual convention of the Society will be held February 4 to 9 inclusive, at Hotel Traymore, Atlantic City, N. J. Activities will include the reading of papers and reports, an exhibit, plant trips, etc. The New Jersey Clay Workers Association and Eastern Section of the American Ceramic Society will be hosts.

The 1924 summer excursion will be to the Pacific Coast. This will offer a fine itinerary and a wonderful opportunity to see up-to-date manufacturing and new deposits of ceramic materials.

The 1925 annual convention will be a joint celebration with the Ohio State University of the thirtieth anniversary of the founding by General Orton of the world's first collegiate department of ceramic engineerings.

Ross C. Purdy, general secretary, has announced that programs for the annual convention, February 4 to 9, 1924, are now being prepared and requests prospective contributors to notify the program committee as soon as possible of the title and character of their papers.

Coming Meetings

The next annual meeting of the American Ceramic Society will be held at Atlantic City, N. J., February 4 to 9, 1924.

The National Exposition of Power and Mechanical Engineering will be held at Grand Central Palace, New York, December 3 to 8, 1923.

The next annual meeting of the National Ornamental Glass Manufacturers' Association of the United States and Canada will be held at New York, June 24 to 26, 1924.

The National Glass Distributors' Association will hold their annual meeting on December 4 and 5 at the William Penn Hotel, Pittsburgh, Pa.

Eastern Apple Exposition and Fruit Show will be held at the Grand Central Palace, New York City, November 3 to 10, 1923. Exhibits will include: fresh fruits, maple sugar, honey, canned fruit, cider, vinegar and glass containers.

Society of Glass Technology, S. English, secretary, announces that arrangements for meetings for the 1923-24 session are as follows: 1923: October 17, Sheffield; November 21, Leeds; December 12, London; 1924: January 16, Manchester; February 20, Sheffield; March 19, Stourbridge; April 16, Sheffield (annual general meeting); May 21, London and June 18, Sheffield. Details of programs will be announced a week prior to each meeting.

Verified News of Trade Activities

J. H. Werbelovsky's Son, dealers in glass and mirrors, have moved their factory from 83-87 Meserole St., to 57-59 Scholes street, Brooklyn, N. Y.

The Emerson Glass Corporation, Jamestown, N. Y., manufacturers and jobbers of mirrors, plate glass, etc., has increased its capital stock from $100,000 to $250,000.

The Warsaw Cut Glass Company, Warsaw, Ind., has applied for permission to change its name to the **Johnson-Carlson Cut Glass Company.**

The Hazel-Atlas Glass Company of Oklahoma is erecting an addition to one of its warehouses at its Blackwell, Okla., plant and has also let the contract for a new power house building to which as soon as completed the present power equipment will be moved.

At a recent annual meeting of the stockholders of the **Alliance Window Glass Company,** Salem, W. Va., the following officers were elected: T. J. Coffman, president; Frank Laurent, vice-president and general manager; Paul Smidth, secretary, and Remy Delmotte, treasurer.

The Hartford City, Ind., plant of the **American Window Glass Company,** resumed operation on October 15, after being closed for about three weeks during which time complete repairs were made.

An option on 16-acres of ground, formerly the site of the Pittsburgh Plate Glass Company's plant at Tarentum, Pa., is reported to have been obtained by T. N. Gummert and S. F. Lucas of that city, who are endeavoring to organize a company to manufacture plate glass.

The property, including buildings, machinery, etc., of the **Reliance Window Glass Company,** DuBois, Pa., is to be disposed of at a trustees' sale scheduled for Thursday, November 1, 1923, at 1:30 P. M., at the Union Banking & Trust Company, trustee.

The contract for foundation work for an addition to the present Blairsville, Pa., plant of the **National Plate Glass Company,** has been let to the John F. Casey Company, of Pittsburgh, and a contract has also been closed with the Mississippi Valley Structural Steel Company, of Decatur, Ill., for the structural steel and iron in connection with this building program.

The Pacific Coast Glass Works, Inc., San Francisco, Cal., C. N. Davis, vice-president, announce that they are completely modernizing their plant and that about 75 per cent of the work has been completed. The outlay for the improvements will total about $250,000 and includes two tanks of their own design, the first having been in operation since May 1, 1923 and the second it is expected will be put in operation January 1, 1924. Six Simplex eight-foot muffle lehrs, Howard feeders and Lynch LA machines and other automatic machinery to replace semi-automatic, have also been installed.

The Monongah Glass Company, Fairmont, W. Va., recently sold a large issue of bonds for the purpose of making improvements and providing additional working capital. Robert Garrett & Sons, Mackubin, Goodrich & Co., of Baltimore, and McLaughlin, MacAfee & Co., of Pittsburgh, were the purchasers. The issuance of these bonds will mean a large increase in production within the next 18 months and the taking on of many more employees.

The Container Testing Laboratories, Inc., Rockaway, N. J., of which Albert W. Luhrs is president; Charles J. Zusi, vice-president and Albert C. Nolte, secretary-treasurer, has established a consulting engineering service for makers, users and shippers of containers, specializing in the following activities: redesigning present containers to reduce shipping costs and damages; designing and testing new types of containers and containers for new products; performing laboratory tests for shippers, railroads and container or accessory manufacturers; preparing and rendering opinions for use in hearings of committees and commissions as well as in lawsuits.

Personal Items

Ralph F. Brenner, formerly chief chemist of the H. C. Fry Glass Company, Rochester, Pa., is now connected with the Vitrolite Company, of Parkersburg, W. Va.

Paul M. Offill, who recently resigned as Pittsburgh representative of the Laclede-Christy Clay Products Company is now associated with the Simplex Engineering Company, Washington, Pa., as sales engineer.

Irving E. Adams, the well-known chemical engineer and glass consultant, has terminated his contract with the J. E. Marsden Glass Works, Inc., Ambler, Pa., and is continuing his general glass consulting work from 623 North Spring Garden street, Ambler, Pa.

Norman L. Niece, son of W. C. Niece, superintendent of the Hartford City, Ind., plant of the American Window Glass Company, has been appointed assistant superintendent of the No. 4 plant of that company at Bellevernon, Pa. Mr. Niece was formerly employed at the Arnold, Pa., plant.

M. G. Babcock, formerly sales representative of the Laclede-Christy Company of Pennsylvania, has succeeded P. M. Offill, who recently resigned, in charge of the Pittsburgh office of the Laclede-Christy Clay Products Company of St. Louis, at 901 Oliver Building, Pittsburgh, Pa.

Fred R. Low, of New York, a veteran editor in the engineering field, has been elected president of the American Society of Mechanical Engineers to succeed John L. Harrington, of Kansas City, Mo. The election was conducted from the headquarters of the society in New York by mail ballot.

Inquiries Received

For further information address THE GLASS INDUSTRY

154. Will you kindly request manufacturers of window glass machinery and equipment for cutting and polishing glass to send us their catalogs? L. H. Shen, China General Edison Company, 140 Ribison Road, Shanghai, China.

155. Do you know of any equipment for spraying glass in its molten condition upon the surface of an electric metal sign, for example?

156. Please give me the names of eastern concerns who could manufacture hair tonic bottles of special design.

157. Would like the names of concerns that can manufacture about a thousand glass ash trays with advertising imprint either etched or with embossed letters molded into the glass.

158. Can you give me the names of manufacturers of ruby fifteen-hour votive night light glasses for churches?

159. Where can I obtain in large quantities glass vials 7/16 in. outside diam., 3¼ in. long, with thin walls?

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, OCTOBER 26, 1923

	Bid	Ask	Last
American Window Glass Machine, common	88	89	89¼
American Window Glass Machine, preferred	92	95	93
American Window Glass, preferred	108½	..	110
Pittsburgh Plate Glass	195	200	196
U. S. Glass	24	25	24⅞

The market has been strong throughout the month with the exception of U. S. Glass, which has shown a weakening tendency. There is talk in certain quarters of a coming extra disbursement upon Pittsburgh Plate Glass, but there has been no announcement concerning such action from official sources. It is understood that all the companies are showing good earnings and that 1923 will prove to be a record year for the industry.

WHEELING STOCK EXCHANGE, OCTOBER 26, 1923

	Bid	Ask	Last
Hazel-Atlas	35	36	36
Imperial Glass	95	..	99½
Fostoria Glass	140	..	140
Central Glass	95	100	90

A very quiet market has prevailed for the last month and in most instances the price undertone has been weak. Recent reports show that the earnings of the different companies are very satisfactory and it is said that present indications point to a continuance of satisfactory operations.

TOLEDO STOCK EXCHANGE, OCTOBER 26, 1923

	Bid	Ask	Last
Owens Bottle Machine, common	41⅛	..	44¾
Libbey-Owens Sheet Glass, common	132	138	
Libbey-Owens Sheet Glass, preferred	105	109	..

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

October 25, 1923

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)...lb.	.05	.05½
Aluminum oxide (Al_2O_3).....lb.	.06½	.07
Antimony oxide (Sb_2O_3).....lb.	.07	.07½
Arsenic trioxide (As_2O_3) (dense white), 99%.....lb.	.13	.13½
Barium carbonate ($BaCO_3$).....ton	70.00	90.00
Barium hydrate ($Ba(OH)_2$).....lb.	.05½	.05¾
Bone ash.....lb.	.07	.08
Borax ($Na_2B_4O_7 10H_2O$).....lb.	.05½	.06
Borax, fused ($Na_2B_4O_7$) any mesh.lb.	.19	.20
Boric acid (B_2O_3), fused.....lb.	.35	.35
Cadmium Sulphide (CdS)—		
Red.....lb.	..	1.65
Orange.....lb.	..	1.55
Yellow.....lb.	..	1.65
Chrome Oxide (Cr_2O_3).....lb.	.35	.37
Cobalt Oxide (Co_2O_3)—		
In bbls.....lb.	..	2.10
In 10 lb. tins.....lb.	..	2.20
Copper oxide—		
Red (Cu_2O).....lb.	..	.15–16
Black (CuO).....lb.	..	.26
Black prepared.....lb.	..	.30
Cryolite (Na_3AlF_6).....lb.	.09	.09½
Feldspar—		
100 mesh.....ton	11.50–16.00	20.00
80 mesh.....ton	..	..
40 mesh.....ton	..	..
Ferrous oxide (FeO).....lb.	..	..
Fluorspar (CaF_2)—		
Powdered white, 95%.....ton	48.00	60.00
Powdered white, 90%.....ton	45.00	55.00
Hydrofluoric acid (HF) 60% (in lead carboys.....lb.	..	.13
Kaolin (f.o.b. mine).....ton	8.50	20.00
Lead Oxide (Pb_3O_4) (red lead)...lb.	..	.11
Litharge (PbO).....lb.	..	.10½
Lime—	Carlots	Less Carlots
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks).....ton	12.50	..
Burnt (CaO) ground, in bulk.ton	9.00	..
Burnt, ground, in paper sacks.ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl....	2.15	2.30
Magnesium carbonate ($MgCO_3$)...lb.	..	..
Manganese 85% (MnO_2).....lb.	.03½	.04
Nickel oxide (Ni_2O_3), black, for nickel content.....lb.	.32	..
Nickel monoxide (NiO), green, for nickel content.....lb.	.30	..
Potassium carbonate—		
Calcined (K_2CO_3) 90%.....lb.	.06½	.07
Hydrated (KOH) 90%.....lb.	.07	.07¾
Potassium nitrate (KNO_3) (gran.).lb.	.06¼-.06½	.06½-.06¾
Potassium Permanganate ($KMnO_4$).....lb.	..	.17
Powdered blue.....lb.	..	.24–.26
Standard formula.....lb.	..	.38
Salt cake, glassmakers (Na_2SO_4), f.o.b. works.....ton	25.00	30.00–40.00
Selenium (Se).....lb.	..	2.10–2.85
Soda ash (Na_2CO_3) dense, 58%— f. o. b. works.		
Bulk.....Flat 100 lb.	1.40	..
Bulk, on contract....Flat 100 lb.	1.35	..
In 400 lb. barrels, on contract..lb.	1.69	..
In 300 lb. bags, on contract....lb.	1.45	..
Sodium nitrate ($NaNO_3$), refined..lb.	.04-.04¼	.04¼-.04½
Sodium selenite (Na_2SeO_3).....lb.	1.90	2.00–2.50
Sodium Fluosilicate (Na_2SiF_6)....lb.	.07¾	.08½
Sulphur (S)—		
Flowers, in bbls.....Per 100 lb.	3.25	3.55–3.80
Flowers, in bags.....Per 100 lb.	3.00	3.30–3.55
Flour, heavy, in bbls..Per 100 lb.	2.50	3.50
Uranium oxide (UO_3), 100 lb lots.lb.	..	2.25
Zinc oxide (ZnO).....lb.	..	.08½

Monthly Summary of United States Foreign Commerce in Glass

Exports

Corrected to September 22, 1923

	August 1922 Quantity	August 1922 Value	August 1923 Quantity	August 1923 Value	Eight Months Ending August 1922 Quantity	Eight Months Ending August 1922 Value	Eight Months Ending August 1923 Quantity	Eight Months Ending August 1923 Value
Glass and glass products (total).....	.....	$663,441	.....	$878,758	.....	$5,615,036	.....	$7,389,184
Plate and window glass—								
Window glass, common, box 50 sq. ft.....	2,854	16,103	3,307	18,884	22,042	116,126	31,829	173,572
Plate glass, unsilvered, sq. ft.....	103,501	44,262	66,843	44,012	2,122,676	880,526	1,524,391	634,979
Other window and plate glass, n. e. s.....lbs.	188,061	17,716	282,769	26,829	1,217,646	139,683	2,560,144	286,715
Glass containers (bottles, vials and jars).....lbs.	4,039,235	213,583	6,294,286	308,770	26,208,784	1,462,903	50,405,684	2,417,340
Table glassware, plain.....lbs.	1,672,225	156,200	1,769,928	198,784	7,341,880	828,473	13,494,610	1,485,502
Table and other glassware, cut or engraved....lbs.	35,701	14,651	21,239	10,040	267,177	101,780	354,269	138,328
Glassware for lighting—								
Lamp chimneys and lantern globes.....lbs.	82,495	18,912	132,003	28,697	903,155	191,287	1,309,015	261,923
Globes and shades for lighting fixtures.....lbs.	112,613	34,084	164,748	42,990	949,915	276,602	988,052	300,421
Lamps and other illuminating devices, chiefly of glass.....lbs.	62,758	20,620	124,295	33,991	728,032	264,879	1,059,638	266,426
Chemical glassware.....lbs.	19,300	12,005	26,056	18,305	199,951	104,672	149,324	109,120
Electrical glassware, except for lighting.....lbs.	287,415	14,051	151,700	11,312	1,321,643	105,781	1,861,347	124,248
Other glassware, n. e. s.....lbs.	654,879	101,254	672,651	136,144	9,418,795	1,142,324	6,839,444	1,190,610

Imports

Corrected to September 22, 1923

	August 1922 Quantity	August 1922 Value	August 1923 Quantity	August 1923 Value	Eight Months Ending August 1922 Quantity	Eight Months Ending August 1922 Value	Eight Months Ending August 1923 Quantity	Eight Months Ending August 1923 Value
Glass (total).....	.....	$1,300,912	.....	$2,863,774	.....	$8,003,224	.....	$15,998,006
Cylinder, crown, and sheet, lbs.....dut.	3,329,273	142,537	.....	.....	38,311,491	1,932,411	.....	.....
Unpolished, lbs.....dut.	.....	.....	5,796,014	227,564	.....	.....	35,433,333	1,546,404
Bent, ground, beveled, colored, painted, etc., and polished.....dut.	.....	.....	.....	75,809	.....	.....	.....	559,871
Plate glass—								
Unsilvered, sq. ft.....dut.	1,263,421	576,085	3,247,040	2,000,018	5,251,428	2,360,761	17,268,742	10,109,223
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft.....dut.	.....	.....	277,018	37,718	.....	.....	1,693,514	265,477
Containers—bottles, vials, etc.....dut.	.....	31,474	.....	20,545	.....	189,793	.....	158,548
Table and kitchen utensils, lbs.....dut.	.....	.....	47,275	13,402	.....	.....	257,945	84,838
Glassware, cut or decorated, lbs.....dut.	.....	229,570	572,717	184,565	.....	1,384,656	2,362,376	878,674
Blown glassware, n. e. s., lbs.....dut.	.....	.....	575,574	130,547	.....	.....	3,972,960	820,121
Other glassware.....free	.....	9,887	.....	.....	.....	85,789	.....	.....
Other glassware.....dut.	.....	311,359	.....	173,606	.....	2,049,814	.....	1,574,850